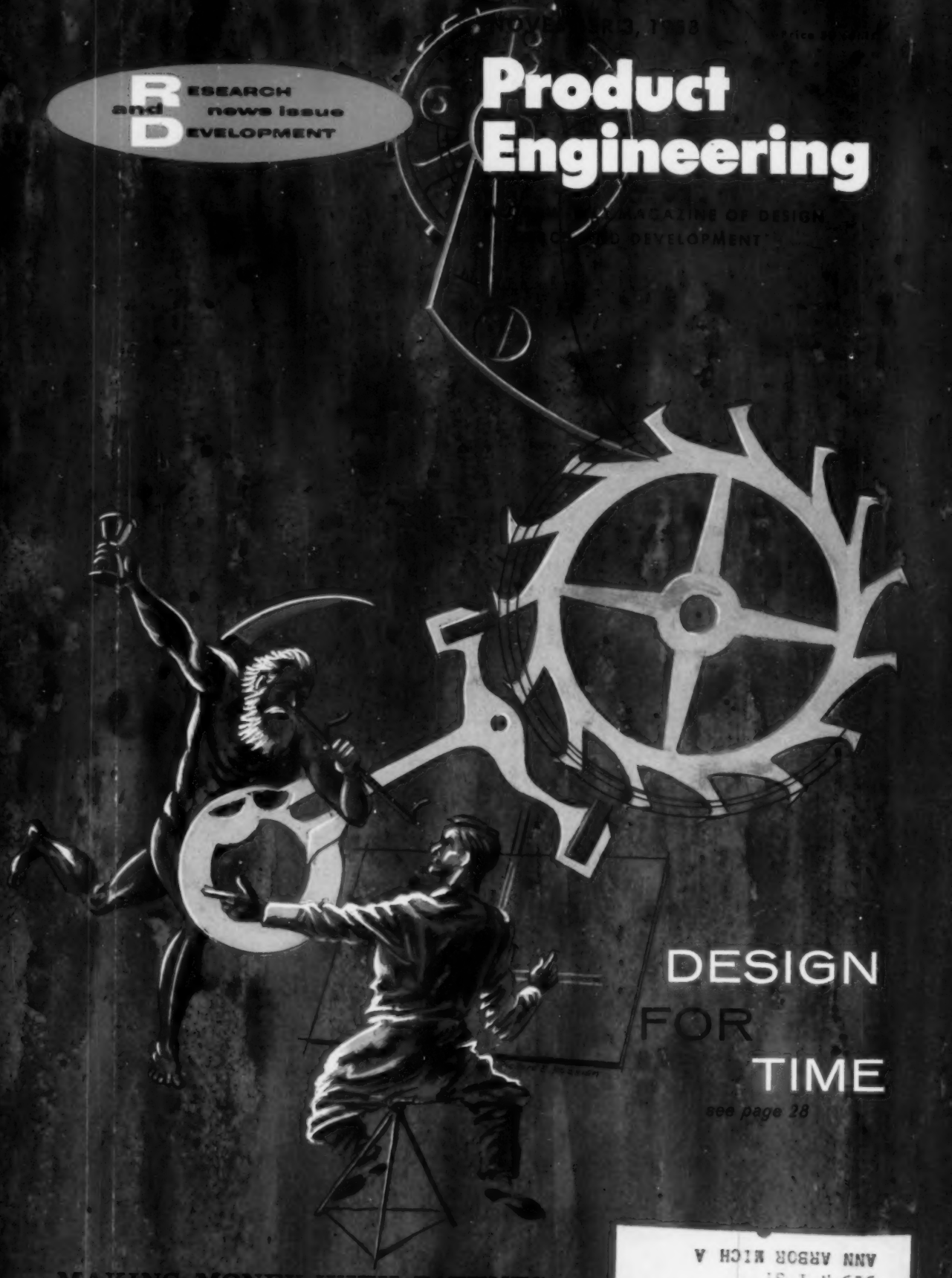
NOVEMBER 3, 1958 Price 50 cents

R and D RESEARCH and DEVELOPMENT news issue

Product Engineering

THE MAGAZINE OF DESIGN, RESEARCH AND DEVELOPMENT



DESIGN FOR TIME

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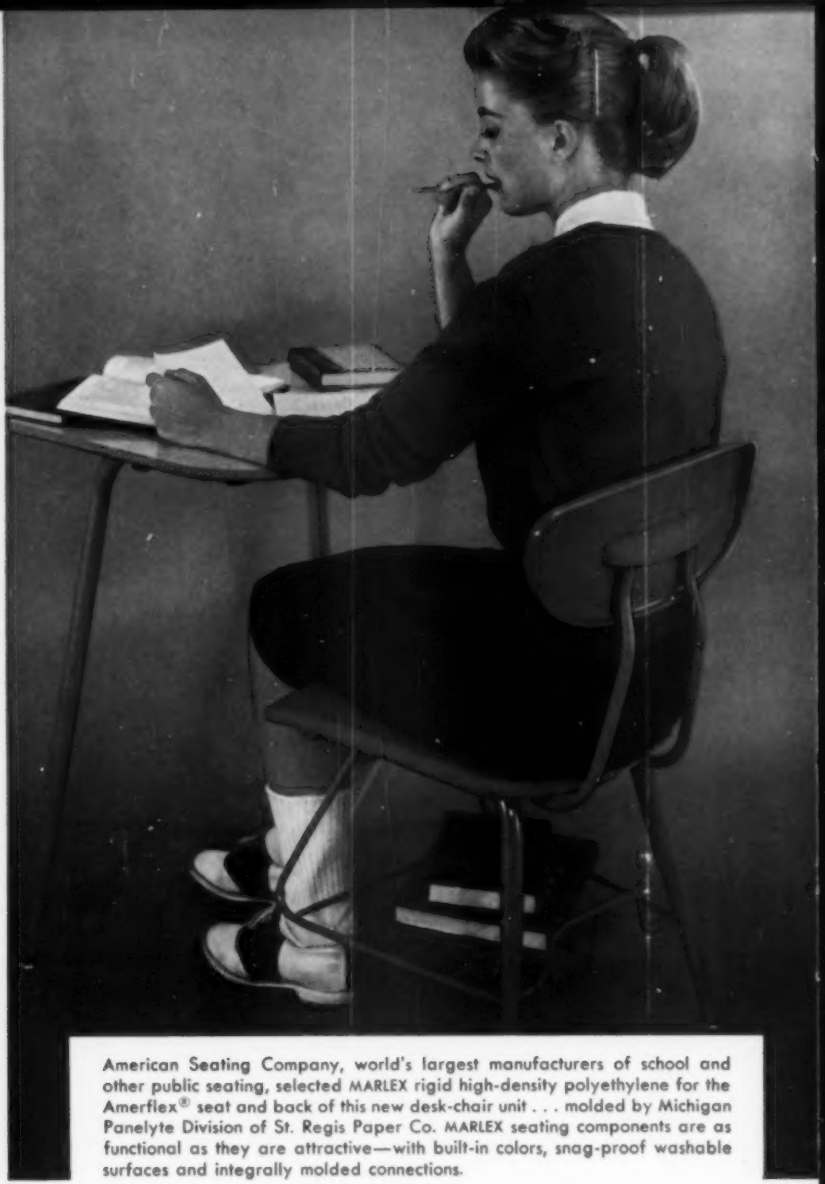
MAKING MONEY WITH PATENTS

see page 24

E B POWER GS D
UNIVERSITY MICROFILMS I
313 N 1 ST
ANN ARBOR MICH A

New MARLEX furniture components include: (1) drawer glides and bearings molded by Prolon Div., Pro-phy-lac-tic Brush Co., Florence, Mass. (2) "Floormate" furniture glides, made by Childlore Corp., Kansas City, Mo., and (3) self-lubricating center drawer guides, glides and dowel pins molded by Reiss Mfg. Co., Little Falls, N. J.

MARLEX filaments are woven into attractive long-wearing upholstery and drapery fabrics such as the material on this office chair (below right), as well as durable, weather-proof furniture webbing like this popular "do-it-yourself" material woven by Thomas Taylor & Sons for Webcraft, Inc., Bridgeport 6, Conn., who developed this new market.



American Seating Company, world's largest manufacturers of school and other public seating, selected MARLEX rigid high-density polyethylene for the Amerflex® seat and back of this new desk-chair unit . . . molded by Michigan Panelyte Division of St. Regis Paper Co. MARLEX seating components are as functional as they are attractive—with built-in colors, snag-proof washable surfaces and integrally molded connections.

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*MARLEX is a trademark for Phillips family of olefin polymers.

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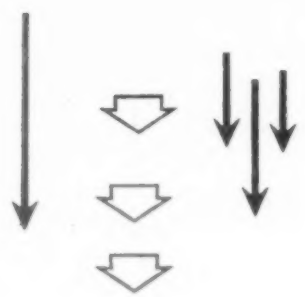
MARLEX

EXCLUSIVE INTERVIEWS
on important
questions of the day
are part of the regular
features in this
R and D news issue

COLLEGE
PRESIDENTS and DEANS
senators and representatives
company presidents and vice presidents
chief engineers
and directors of research
have discussed

- *The new-model-every-year philosophy*
- *Collective bargaining for engineers*
- *What the engineer needs to become a good manager*
- *Congressional committees and their influence on research*



IN THIS ISSUE the editors ask

- *How much should a company automate?*

DON'T MISS IT!

coming next week . . the DESIGN issue for November 10

FEATURING

- **Which type of spring is best?**
  Equations and tables comparing springs for energy absorption.
- **New techniques in lubrication**
  A review of 10 research papers presented at the ASLE/ASME conference.
- **Designing for reliability**
  A test for reliability and how to avoid designs that will give trouble.
- **How much stress on a bearing ball?**
  These curves indicate permissible loads when seat is curved or flat, steel or aluminum.
- **Better non-clogging centrifugal pumps**
  New designs of a special impeller which won't clog when handling pulpy liquids.
- **Best recipe for casting urethane foam**
  Cavity design, resin choice, production controls for rigid foam casting.
- **Packed glands for high pressure**
  Packings and gland-design hints that can help answer sealing problems.

Product Engineering

McGRAW-HILL MAGAZINE OF DESIGN, RESEARCH AND DEVELOPMENT

R and D RESEARCH and DEVELOPMENT news issue

November 3, 1958 Vol. 29, No: 45

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Product Engineering . . . . . SIDELIGHTS

R ESEARCH and news issue D EVELOPMENT

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● **"The Conquest of Time"** is the theme of three paintings by Hans Erni that decorate the walls of the horological exhibit in the Swiss Pavilion of the Brussels fair—and our cover. Watches (p. 28) are now part of our everyday lives—we use time as an essential component of most of our products. But while we control electricity, heat, even atomic energy to some extent, no one controls time. We only note its passage. . .wistfully, for the most part.

● **Mass production and automation** (p. 30) got a severe blow last month, and from General Motors of all companies. It was the French branch, which may have something to do with it, but each of ten famous French artists was asked to decorate a refrigerator donated by GM. Under the title, "The Nobility of Everyday Objects," the refrigerators were exhibited in the US, and these one-of-a-kind 3-D paintings are something to see. Our favorite depicts a house in the south of France. A pretty girl stands in the doorway, another looks pensively out a window. Our own kitchen will never recover from the blow.

● **The latest on handwriting analysis** comes from the analyst herself. Of the eight readers who asked us for the name of a handwriting expert, three had the courage (or curiosity) to forward a sample for study. One plans to use the recommendations to check on employees, another to check on an engineer. The third sent along a sample of a woman's handwriting to find out what kind of a wife she'd make.—Wish we'd thought of that.

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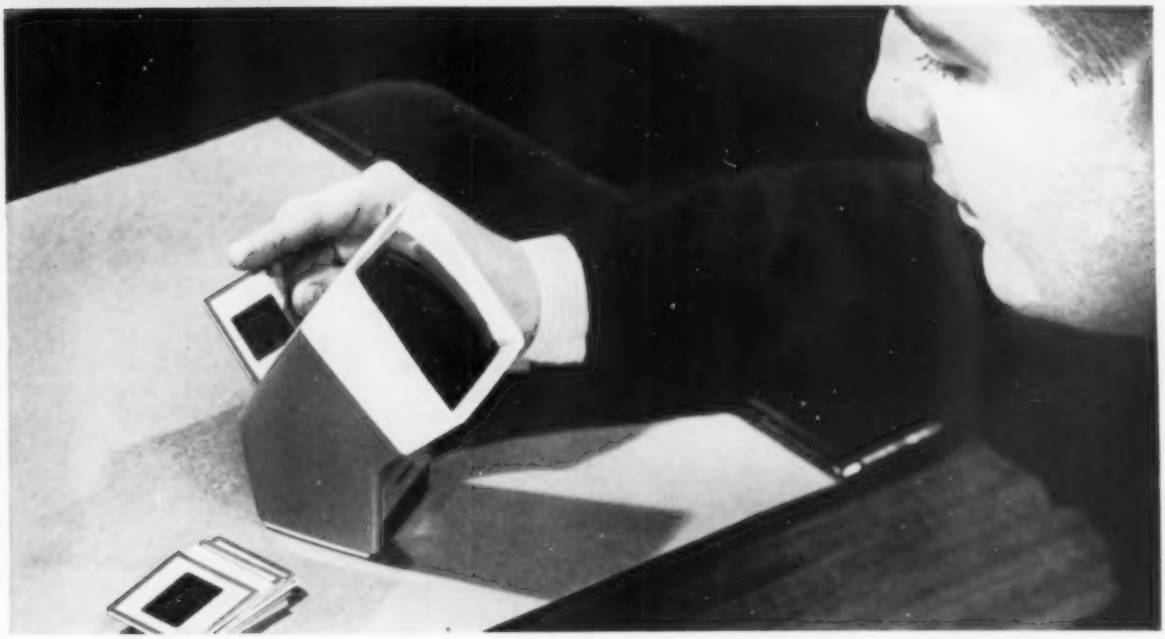

ARGUS SLIDE VIEWER focuses on CYMAC® 400

A number of advantages made CYMAC 400 polymethylstyrene plastic ideal for the smartly designed case of the new Argus PreViewer II color slide viewer. CYMAC 400 resists heat and will not warp when the bulb is lighted for an extended period, or when the viewer is exposed to the hot sun in store windows. It resists stains and may be wiped clean. And it lends itself to attractive design in two tones of blue—color that won't chip off. CYMAC 400 is economically injection-molded for Argus by the Parts Division of Sylvania Electric Products, Inc.

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DEVELOPMENTS TO WATCH...

Second change in auto mufflers . . .

. . . after years of stagnation may come close on heels of the first. That one was introduction of coated steel elements (galvanized and aluminized) on the '59 models. Now, an even greater change is on the way.

Stainless-steel producers have long eyed the muffler market, well aware that increasingly corrosive passenger-car exhaust gases would make stainless an obvious choice. The problem, of course, has been cost.

Now, though, at least one stainless producer has a brand-new design, with a new internal configuration. The company claims this design can be made considerably smaller than standard types and produced in stainless at a competitive price—competitive with the coated steels if not with the old bare-steel models.

There are still problems to be solved—not all of them involving design. But the company has high hopes of putting the new unit on the market within two years.

Hydraulic fluids and engine oils . . .

. . . with thermal stability to 650 F and good lubricity can be produced from silane base stocks, Air Force researchers say.

They claim that alkyl and alkyl-aryl silanes are "comparable to non-additive mineral oils and superior to chlorinated silicones" in wear properties and can be improved by conventional wear additives also.

In flash and fire points, the silanes also "proved superior to both hydrocarbon and ester fluids."

Research is continuing, but a preliminary report is now obtainable from OTS. It's "Laboratory Evaluation of Silane Fluids," PB 131889, 32 p, $1.

Semiconductor rectifiers can be designed . . .

. . . for service at 750 F or higher by taking advantage of such materials as gallium arsenide and indium phosphide, say RCA engineers. Having already made devices that operate successfully at 650 F, they are now shooting for the higher range. Under Air Force sponsorship, they plan not only to develop power rectifiers, but also computer diodes and transistors, and expect to produce units that will operate at considerably higher temperatures and frequencies than is possible with germanium and silicon.

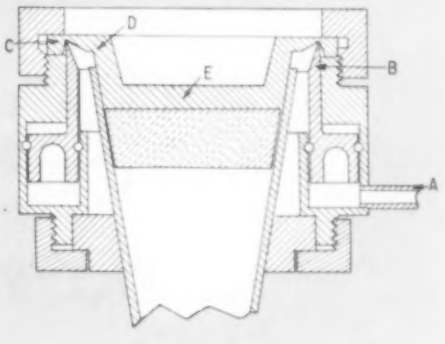
A "brake" for guided missiles . . .

. . . has been developed by a California engineer, and the Army thinks enough of it to have taken over the patent. Technically, it's a "thrust cancellation device" for solid-propellant rockets.

Army's big interest lies, of course, in what the device offers for precise control of rocket trajectories. But it might also open the way for controlled application of other propellant-actuated devices in the industrial field (*PE—Jan 6, p 56*).

The "brake" is simple—paired auxiliary nozzles are located at the throat of the main nozzle and at a 60-degree angle to it. The auxiliary nozzles have approximately the same throat area as the main nozzle. Normally, they are closed. But when thrown open, they dissipate the propulsive gas, dropping the net force acting on the rocket almost to zero.

Key to successful operation of his device, says the inventor, is capping the auxiliary nozzles. For effective braking, the cap must break cleanly and quickly. One possible design is at the right. —ARG



Cap for auxiliary nozzles that serve as missile brake can be operated by high-pressure fluid from explosive charge. In this design, fluid enters through connection A, and drives a shear blade B forward, severing the flange C of the cap D, and forcing the seal E out of the nozzle.

LINK-BELT P.I.V. means positive, infinitely variable speed control

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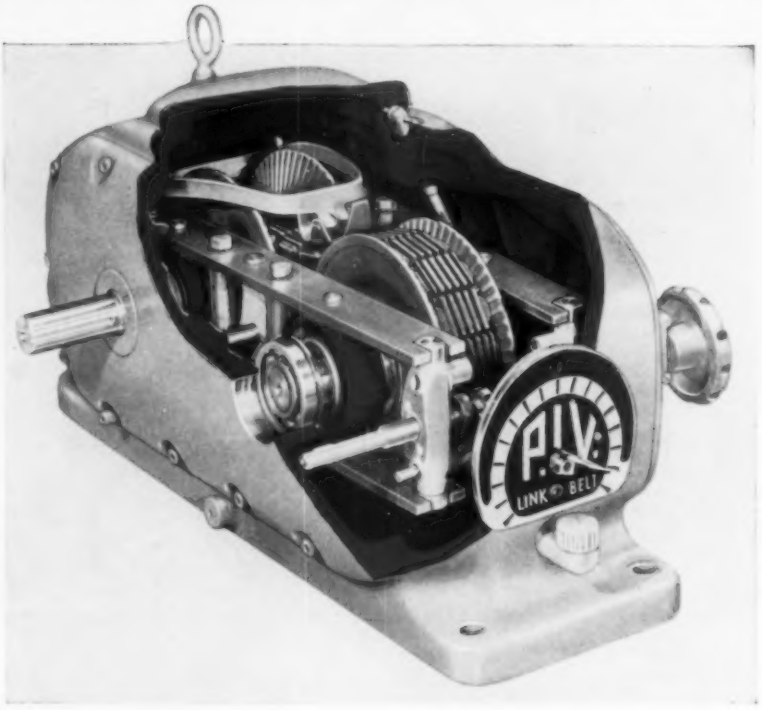
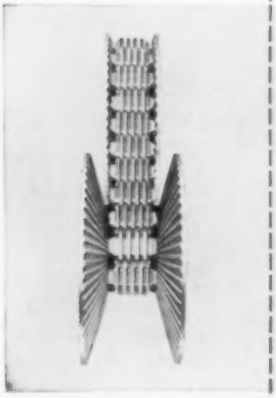
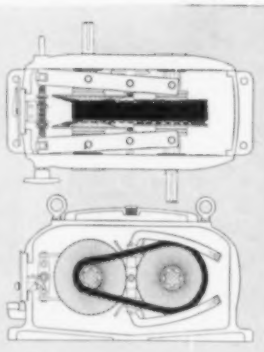


LONG-LIFE ACCURACY and application flexibility of Link-Belt P.I.V. are unmatched by any other variable speed drive. It's available in 8 sizes and 16 standard types, in capacities from ½ to 25 hp—for horizontal or vertical mounting. Compact design simplifies installation as a separate unit or a built-in part of a machine. Even greater application flexibility can be gained by making motor and helical gear sets integral parts of the P.I.V. Of all-metal construction, P.I.V. is totally enclosed, automatically lubricated.

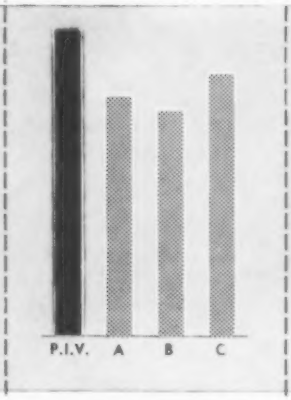
How LINK-BELT P.I.V. differs from other variable speed drives



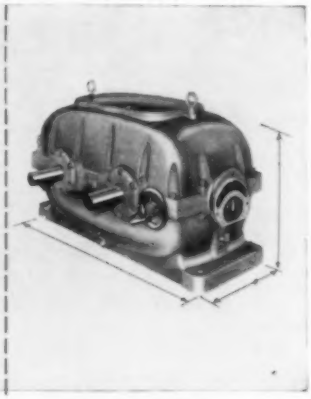
POSITIVE MESH of self tooth-forming chain with grooved wheels assures full-rated hp at output shaft. All-metal construction . . .



PREVENTS SLIPPAGE because the P.I.V. drive chain does not depend on friction and is unaffected by atmospheric conditions.



UNMATCHED ACCURACY is demonstrated by this actual comparison of maintained rpm of P.I.V. and three other variable speed drives.



GREATER COMPACTNESS results from short-center arrangement of drive mechanism. Some P.I.V. models save 50% on floor space.

DEVELOPMENTS TO WATCH...

A low-cost, high-speed missile target . . .

is being requested by the Navy and Air Force. What the two services want is an air-launched, high-altitude, expendable target for missile-firing fighter and interceptor aircraft.

The Pentagon says the target can be a medium sized rocket- or ramjet-propelled aircraft with short flight duration. But, designers are not limited in proposals as long as they meet the basic need.

The target must be ready for use by 1961 for air-to-air missile firing practice that will be needed for new aircraft slated to be in operation by that date. But, such a target will be in demand for other uses. Navy wants to use it for testing shipboard-launched guided missiles, too. Companies interested in the project should contact the Navy Bureau of Aeronautics.

Patent applications will get quicker action . .

–and soon. That's the word from the US Patent Office which has high hopes of "considerably" reducing the current 13-month lag between time of application for the average design patent and final issuance or denial. The goal–expected to be attained by early 1959–is an average time lag of no more than six months, actually only three months for patents granted on the first round of application.

A sharp reduction in this period is bound to benefit manufacturers seeking patent protection on their designs. One of their big problems under the present set-up is that–with so many design patents sought for seasonal type products–frequently patents are issued too late to prevent copying by competitors while the product is still a hot seller.

Government officials right now are giving serious thought to whether the US–the only major country offering full patent rights for ornamental designs–ought to modify its laws along the lines of the far simpler design copyright system used by most other countries.

Greater uniformity in the protection offered designers by various governments was one of the most of topics slated for review at the 45-nation meeting to revise the international convention for the protection of industrial property. The meeting–the first since 1934—was held at Lisbon Oct 6-30.

Under the system used abroad, designers need only register new designs with the government–a much faster route to protection than that prevailing here where all applications are carefully examined for novelty and patentability. Also, registered designs are not required to be distinctly different from already existing product designs to qualify. On the other hand, the US design patent owner can sue copiers who infringe without prior knowledge of the existing patent. Under foreign registration systems, such suits are valid only for knowing infringement.

More titanium in missiles . . .

and aircraft is predicted with the announcement of Mallory-Sharon new titamium alloy MST 881. Ultimate tensile strengths of about 100,000 psi at 1100 F are claimed for normal use, and 50,000 psi at 1400 F. No figures were released on the new metal's welding qualities but M-S says preliminary tests look good.

Alloying elements of MST 881 are 8% aluminum, 8% zirconium, and 1% tantalium and columbium.

Applications being considered are for Mach 3 jet engines and missile casings. Currently Mallory-Sharon and Aero-Jet General are experimenting with the alloy for possible use in the Navy's Polaris missile.

Watch for transportation costs to drop . . .

A real fight has been touched off between the railroads and truckers in Washington over efforts of the rails to cut freight rates. The railroads want to junk the traditional method of setting freight charges, geared to value of items being hauled. Substituted would be rates based on straight weight basis.

The economics are enticing to shippers. Under the B & O's rate proposal, charges would be cut to 64.5 cents per 100 lb–based on a 70,000-lb minimum hauled in two boxcars–from a current charge of $2.02 per 100 lb from New York to Chicago, based on a 30,000-lb min.

The B & O, New Haven and others have asked the Interstate Commerce Commission for the new rates; the truckers have blocked a decision until next March 14.

World-wide ...

DEVELOPMENTS TO WATCH...

Molybdenum disilicide heating elements . . .

. . . are receiving new attention in Germany. Oxidation resistance (to at least 3000 F in air) and formability are two reasons.

There are problems, though, especially in making electrical connections. It is difficult to keep the contacts from heating up; and, in an oxidizing atmosphere, they are likely to develop oxide coatings that can seriously interfere with current flow.

Nevertheless, a number of heating elements have been made of this material and successfully applied in electrical resistance furnaces and other applications; and German engineers, including a group at Siemens-Planiawerke AG, think enough of it to keep the development program an active one.

The low point of "low temperature" . . .

. . . apparently has not yet been reached.

A few years ago −65 F was considered unusual, and was adopted as the specification for most military equipment. Next, −100 F became the goal. Then, early this year IGY scientists in the antarctic reported ground temperatures of −102.4, and calculated that −108 might might be encountered.

Now, Soviet explorers say that on at least two occasions they've recorded temperatures as low as −125 F; and several of their stations have had temperatures in the neighborhood of −100.

What is the lowest possible ground temperature? One estimate is −130 F. But temperatures as low as −134 F have been recorded at altitudes of only a few miles, and might well occur at ground level. However, any such temperatures would hardly occur often enough to influence design specifications. The range of −100 to −115 F, though, seems to rate closer consideration.

With increasing interest in the antarctic, and, of course, the interest in outer space, this could mean still another revision of low-temperature specs.

Copper so pure its purity can't be measured . . .

. . . by ordinary chemical means is being turned out at the British GE Laboratories, Wembly, England. They're producing the metal with an improved zone-refining technique. Then, purity is determined by drawing the ingot into wire and measuring its resistivity at liquid helium temperature in a specially designed cryostat.

As the GE researchers point out, at this temperature—close to absolute zero—the contribution to resistivity of the thermal vibration of atoms is eliminated, leaving only the lattice distortion to interfere with conductivity, and this distortion is a function of the contained impurities.

Ultrapure tantalum is also being produced at the laboratories, but by a different route. Here, taking advantage of tantalum's high melting point (5425 F), impurities are volatilized by heating the metal under high vacuum.

The aim in both cases is better materials for lamps, electronic tubes, and control devices.

Transistorized amplifier that packs 45-w . . .

. . . power output in an 8-lb unit only 7¼ by 4½ by 5½ in. has been designed in Switzerland. Aimed at the hi-fi market, it will operate on "any battery from 3 to 15 v" (the 45-w output is obtained with a 12.6-v input), takes "only about one-tenth the current" consumed by a standard amplifier of the same capacity. It has separate connections for microphone and phonograph, is said to show a distortion factor of less than 3% at 25-w output.

New amplifier, built by Velectra of Bienne, Switzerland, is said to be temperature-controlled and vibrationproof.

Highest Quality and Most Economical . . .

Quietest Direct Drive Blower Motor

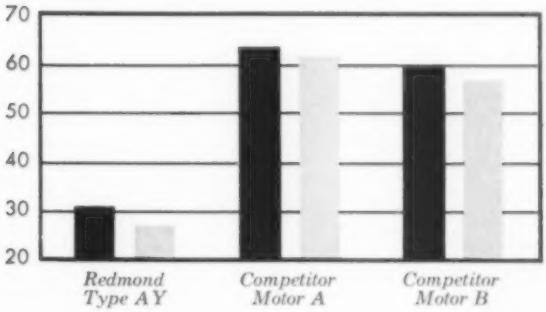
Redmond's New Design Reduces Blower Vibration to One-Fifth that of units using Conventional Shaded-Pole Motors

Place a mechanic's stethoscope on the end cap and you can easily hear the difference between the newly-designed Redmond Type AY and motors of conventional design. Try it on a Redmond 1/6 hp—the noise level is about that of a 1/35 hp motor of conventional design.

Apply vibration tests and you will be quick to agree that here is the quietest direct-drive blower motor available. The AY Tri-Flux motor is designed and manufactured in every way to give years of trouble-free service and whisper-quiet operation. The positive oil system provides force-feed lubrication. Recirculating the oil assures maximum bearing life.

The graph shows vibration test results on the new Redmond design and two competitive motors. These tests were made with the best vibration testing equipment available. The solid black bar shows vibration on the motor end cap; the gray bar shows vibration on the blower housing. The graph is decibel readings on 120 cycles, since the 120 cycle frequency is the one that is the basic source of nearly all noise problems. Reduction of vibration is a logarithmic function—the reduction of vibration in the Redmond motor to 33 decibels reduces noise to only 1/5th that of conventional motors.

The new AY is ideal for a wide variety of applications requiring a whisper-quiet, economical, high-quality motor. Contact us at Owosso, Michigan, and we will have the Redmond sales engineer in your district call you at once.



The Standard of Dependability

CC Redmond COMPANY, Inc.

Subsidiary of CONTROLS COMPANY of AMERICA

OWOSSO, MICHIGAN

THE BIG NAME IN SMALL MOTORS

What's happening in SCIENCE

Faster particles speed atomic research

Particles that travel faster than light and produce a strange, telltale glow are helping to unlock atomic secrets.

This glow is *Cerenkov radiation*. Now being put to work in nuclear-particle counting devices it may also prove useful in radio-wave generators and in control instruments for the atomic-fusion devices of the future.

If the idea of anything faster than light seems strange, it's easily explained:

The speed of light in a vacuum has not been exceeded. But in other media it's a different story. Accelerated nuclear particles and cosmic rays outspeed light in water and a good many other materials (lead glass and lead nitrate solution, for instance). When they do, they create an eerie blue glow which tips off their presence. (This is, incidentally, the blue glow that looks so pretty in pictures of swimming-pool-type reactors).

Although discovery and explanation of the phenomenon are quite recent, Cerenkov nuclear particle counters for research use are already on the market, and other new devices are on the way.

At the UN Conference on Atomic Energy, Academician J. E. Tamm of the Soviet Union said a Cerenkov generator has been built at the U of Moscow which produces radio waves in the 3 to 10-cm band. Power output isn't high (only a few milliwatts); but it does prove it can be done.

As to fusion devices, it has been shown that an electrical current which is generated in a plasma (the hot, partially ionized gas in which nuclear fusion may occur) will emit high-intensity Cerenkov radiation if its velocity is greater than the velocity of the plasma electrons themselves.

Fuel cell research gets another booster

Fuel cells, the package power sources that promise high efficiency (to 90%) and flexiblity in use (*PE—Feb* 17, *p* 18), have gained another adherent: Allis-Chalmers.

Experimental power source provides current for two small light bulbs at Allis-Chalmers laboratory.

Intrigued by the fuel cell's possibilities as a dc power source for adjustable-speed motors and as a peak-load and standby power source, A-C engineers have built several small-size models, and are planning larger scale experiments.

In the fuel cell, hydrogen and oxygen are the feed materials, with hydrogen being fed at the anode; oxygen at the cathode. The hydrogen reacts with the electrolyte (potassium hydroxide), releasing an electron to the external circuit; while the oxygen, absorbed at the cathode, removes an electron from the external circuit. Thus a current is made to flow, without the generation of heat that normally interferes with operating efficiency.

New words

III–Luminescence

Fluorescence, phosphorescence, and electroluminescence are three of the most important sources of light for products of today and for the future. But it's easy to get them confused.

Here, as the third installment in our continuing glossary of new words of science and engineering, are brief definitions. (For earlier installments, see *PE—June* 16, *p* 10; and *June* 30, *p* 10; and for a full-scale report on electroluminescence, see *Sept* 15, *p* 74.)

Fluorescence: emission of light as a result of stimulation by an electromagnetic or particulate source (generally, a shorter wavelength than the light produced, and generally an X-ray or cathode-ray source).

Phosphorescence: emission of light as a result of a similar process, but with the stimulating source being of longer wavelength than the light produced—ultraviolet for instance.

Electroluminescence: emission of light under stimulation of an alternating electrical field, providing an area source of light that can be shaped as needed.

All three systems provide "cold" light, and sometimes use the same materials. Zinc sulfide, for instance, will respond to all three types of stimulation. The difference lies in efficiency, flexibility, and related characteristics.

atom briefs . . .

Tritium's growing importance as an atomic "tracer" was highlighted again (see below) at an all-day symposium in New York last week. Though tritium's major applications as a tracer are still in the organic-biological field, this radioactive isotope of hydrogen is also showing much promise as an energy source for luminous paints, nuclear batteries, and other components (*PE—Feb* 10, *p* 7). It's one of the most abundant isotopes and potentially one of the lowest in cost.

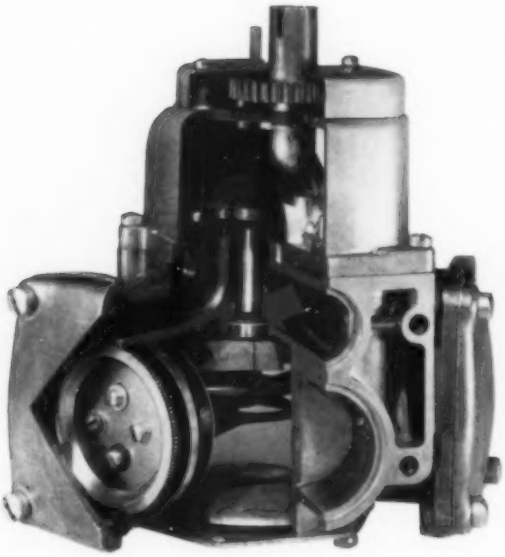
Single copies of a 40-page printed report on last year's symposium on "Tritium in Tracer Applications" can be obtained free of charge by PE readers from the conference sponsor, New England Nuclear Corp, 575 Albany St, Boston 18.

New instruments for atomic research being introduced by Tracerlab Inc, are said to feature increased versatility, easier reading, and simplified maintenance. First on the market is a "super-scaler" which can be set for either a pre-determined count, a pre-determined time, or both (so that whichever one is reached first will shut down the unit). It's offered with a complete set of plug-in accessories (ratemeter, pulse amplifier, utility chassis) at no increase in price over previous models. —ARG

VITON

TRADEMARK

A New Synthetic Rubber from Du Pont Serves Where Other Elastomers Fail



In this meter for gasoline pumps, the O-ring seal on the output shaft is exposed to aromatic components in high octane gasolines. A noted oil-resistant synthetic rubber was first used for the O-ring. It became swollen, however, and caused metering difficulties. When an O-ring of VITON was substituted, the trouble was eliminated.

Gives unequalled service in oils, fuels, solvents and chemicals at temperatures over 400° F.

VITON synthetic rubber combines high resistance to most fluids and corrosive chemicals with outstanding resistance to high temperatures—up to 450° F. in continuous service, up to 600° F. in intermittent service.

VITON offers excellent mechanical properties for a fluid and heat-resistant elastomer. Specimens return to within 90 to 97% of their original dimension after being compressed 25% for 70 hours at 250° F. At room temperature, tensile strength tests out from 2000 to 3000 psi, and ultimate elongation from 100 to 400%, depending upon hardness.

VITON is easy to process; components can therefore be made to close tolerances. This new synthetic rubber has already proved successful in precision seals (such as the one shown here), diaphragms, coated fabric and linings. To learn more about VITON, see your rubber supplier or send for our new booklet. E. I. du Pont de Nemours & Co. (Inc.), Elastomer Chemicals Dept. PE-11, Wilmington 98, Del.

RESISTANCE TO FLUIDS AND CHEMICALS

VITON vulcanizates were immersed for 7 days in a wide variety of corrosive fluids. These data show the effect of representative fluids upon the properties shown.	**Tensile Strength Retained %**	**Hardness Change Points**	**Volume Increase %**
Carbon tetrachloride, 75° F.	85	+ 2	1.3
Aniline, 75° F.	100	— 1	3
Tricresyl phosphate, 300° F.	93	—11	24
JP-5 petroleum aircraft fuel, 75° F.	100	+ 1	0.4
Turbo oil No. 15 diester lubricant (Mil-L-7808), 400° F.	60	— 6	19.6
Transmission fluid, Type A, 212° F.	77	— 1	1.5
OS-45 silicate ester, 400° F.	62	— 3	11.1
Sodium hydroxide, 46.5%, 75° F.	75	+ 1	2.1
Hydrofluoric acid, 48%, 75° F.	98	+ 2	4.8
Sulfuric acid, fuming, 75° F.	58	— 4	4.8

VITON

DU PONT

Better Things for Better Living
. . . through Chemistry

What's happening in MATERIALS

Is zirconium ready now?

Should zirconium be considered in designing next year's models? Is this "new" metal now ready to take its place among the standard materials of construction?

Recent optimistic reports make it look like 1960's "Metal of the Year." But there are still minuses as well as pluses.

In its favor are the metal's strength at elevated as well as room temperatures (some recently developed alloys show yield strength better than 20,000 psi at 800 F), its corrosion resistance, toughness, and availability—of ores as well as refined metal. Price is dropping, too, with a big slice in the past month; and, it is said, "fabrication other than melting, presents no serious difficulties."

On the minus side, though, are hard facts like these:

Despite recent price cuts, zirconium sponge still costs $5 a lb on the commercial market, though the AEC contract price is about $4.50.

Zirconium ingot is about $20 a lb in 500-lb lots, wrought plate is priced at about $30, and tubing runs $40 to $60 a lb.

Scrap reclamation presents severe problems. Heavy scrap can be cleaned and remelted. But, as W. Chubb and R. F. Dickerson of Battelle Memorial Institute point out in a report to the AEC, fine scrap is "excessively contaminated." Since, as with any new metal, the scrap generation rate is still high (over 50% in many cases), this can almost double the finished product cost.

What, then, is the outlook? In nuclear reactors, Chubb and Dickerson say, "It is not overly optimistic to say that the future of zirconium as a material of construction appears assured."

This undoubtedly will mean increases in production, improvements in technology, and eventual lowering in cost. Meanwhile, zirconium is certainly earning the right to be considered for commercial products; but it may be a while yet before it can be specified for everyday use.

Bonded fibers—coming up fast

Production of nonwoven fabrics is booming—up nearly 10-fold in the past eight years (to an estimated 80-90 million lb this year)—and more than half now goes into the industrial field as thermal and electrical insulating materials, backings for plastic films and laminates, electrical tapes, filters, and the like (*PE—Feb* 10, p 16).

As Rudolf Cziner of W R Grace Research Div told the ACS.

Still, much remains to be done before these new materials can reach their full potential.

The bonded fabrics now available are a vast improvement over those on the market eight years ago. They're more pliable, softer, have better absorbency, smoother surfaces, and far greater strength.

briefs . . .

Soft magnetic materials undergo significant changes when exposed to atomic radiation, says Naval Ordnance Laboratory.

In a report on tests of 14 commercially available alloys, NOL says one alloy, Supermalloy, exhibited such a drastic drop in maximum permeability that "it is believed unsuitable for use in magnetic devices operating in radiation environments." On the other hand, the very fact that it does change so much may make it a useful material for radiation indicators.

None of the alloys tested escaped some kind of change; but, NOL says, silicon iron, 16 alfenol, and 2 vanadium permendur were least affected.

A higher order of heat and a flame resistance are unsuspected virtues of its GH-871, phenolic-glass fabric laminate, says National Vulcanized Fibre.

First offered (about a year ago) as a high-strength material for short-term service at 500 F, it now turns out to show good strength retention to 650 F, and may go even higher.

In flame resistance, the material shows an ignition time of 257 sec or more in the proposed NEMA Switchgear Test, and an extinguishing time of 59 sec.

Price changes are again the order of the day in the nonferrous field; and the changes are going both ways.

On the down side are cadmium and platinum, with the former showing the most significant change: 25¢ a lb this year, 10¢ in the past month. Here, the trend seems well established.

In other nonferrous metals, the trend is less clear. Right now, copper, tin, lead, and zinc are rising; but no one is ready to predict how far or for how long. —ARG

New plastic for instrument panels?

Will autos of the 1960s sport dashboard panels like these? DuPont engineers hope so. They molded these experimental designs to show how their new Delrin acetal resin might be used. Though this particular application may turn out to be just wishful thinking, Delrin is expected to find a wide range of engineering uses (PE—Sep 29, p 36). It's slated for commercial production next year.

Delrin dashboards are displayed by DuPont research director.

Naugatuck PARACRIL OZO

The oil-resistant, ozone-resistant nitrile rubber

Now! lasting **COLORS** in rubber wire jackets

A development of Naugatuck research makes it possible to combine in a vulcanized rubber wire jacket all these properties:

- Excellent resistance to ozone and outdoor "weathering"
- Outstanding heat resistance
- High abrasion resistance
- Excellent oil, grease and chemical resistance
- Fast CV extrusion

...**PLUS PERMANENT BRIGHT COLORS**

In addition to the suggested uses, you will think of dozens of other applications where wire jacketing with all these properties can serve either an aesthetic or utilitarian purpose.

One of Naugatuck's technical representatives will be happy to discuss with any prospective user the formulation of the Paracril® Ozo compound which makes possible this combination of properties... not only in wire jacketing but also in shoe soles, hose jackets, weather stripping and other vulcanized rubber products.

Naugatuck Chemical

Division of United States Rubber Company 1142P Elm Street Naugatuck, Connecticut

Rubber Chemicals · Synthetic Rubber · Plastics · Agricultural Chemicals · Reclaimed Rubber · Latices · CANADA: Naugatuck Chemicals Division, Dominion Rubber Co., Ltd., Elmira, Ontario · CABLE: Rubexport, N. Y.

STRENGTH AND UNIFORMITY are outstanding characteristics of the automotive ball-joint bearings shown below. These sintered metal parts demonstrate Moraine Products' capabilities in working with customers to develop the most practical designs. They also demonstrate Moraine Products' responsibilities—making economically, and in quantity, parts that must not fail under the most rugged operating conditions.

Parts shown ½ actual size.

Vital parts for industrial progress

Moraine Products
Division of General Motors, Dayton, Ohio

Product Engineering HORIZONS

November 3, 1958

Recipathy

That's the latest sales word. "Recipathy" is defined by Dr. Wm J. E. Crissy, president of Personnel Development, Inc., as "the impact that the customer-prospect has on the feelings of the salesman and the insight this gives him about the customer-prospect."

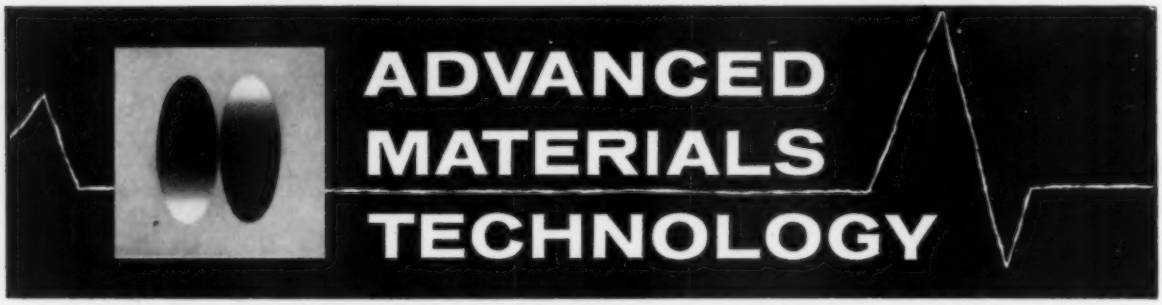
Salesmen as a group seem to be fond of trick words and simple sales formulas. They like to surround their craft with its own terminology, to give it an aura like that of medicine and the law, perhaps. Yet, in sharp contrast, they also like to reduce everything to a formula, a series of steps, a repetitive technique—to make it simple.

That's one reason why the breezy salesman and the analytical engineer lock horns so often, at home or abroad. And it's one reason why the engineer often insists, "Selling is not for me!"

But isn't it? Many salesmen to industry were once engineers; technical societies are knee-deep in them. The explanation is given that a technical product requires technical understanding to sell to technical men. That may, or may not, be true, but it's obvious that some men who had what it took to get a technical degree also have what it takes to be a salesman. So here the classic distinction between extrovert and introvert breaks down, as well as the statement that the engineer deals always with conservative fact, while the salesman rarely does.

The plain fact is that every engineer must be a salesman if he is to get anywhere. He must be able to sell his ideas to his associates and to his management, to build their confidence and belief in what he is thinking and doing.

Come to think of it, we all must be salesmen constantly. We must sell ourselves and our ideas every step of the way. "No man is an island. . . "



THESE CARBORUNDUM ADVANCED MATERIALS MAY HELP YOU SOLVE A DESIGN PROBLEM

Out of hundreds of new materials, many of which have come from electric furnaces, the 6 listed here offer unique advantages. A glance at the tabulation below will show why . . .

MATERIAL	PROPERTIES	FABRICABILITY	FORMS AVAILABLE	TYPICAL APPLICATIONS
BORON CARBIDE An extremely hard abrasion-resistant material produced by the reduction of boric oxide with a low ash source of carbon.	Extremely hard, 9.3 Moh's scale; good high temperature properties; practical working temperature to 4100 F in inert atmosphere, 1000 F in oxidizing atmosphere. Hot pressing or sintering produces good mechanical strength, high strength/weight ratio; brittle, subject to thermal shock; chlorinates readily in fixed or fluid bed reactors at about 1000 C.	Can be formed into solid shapes by hot pressing or sintering.	Solid, grain and powder form.	Lapping of hard metals; mold polishing and rough machining; ultrasonic machining; reactor shielding; reactor control rods; chemical (fuel, feed material).
BORON NITRIDE An easily machined, impermeable ceramic material with unique electrical and corrosion resistance properties for use up to 3000 F.	Density, gms/cc — 2.10 min. (true density, gms/cc — 2.25); working temperature: inert atmosphere, solid — 3000°F. max.; powder — 5000°F. max.; oxidizing atmosphere, solid — 1800°F. max.; powder — 1300°F. max.; dielectric constant — 4÷; dielectric strength — high; electrical resistivity — high; coefficient of friction — low; thermal shock resistance — excellent; permeability — negligible; flexural strength — good; hardness, Moh's scale — 2.	Can be machined at high speeds without lubricant with standard steel cutting tools. May be threaded or otherwise physically joined to form strong, sizeable assemblies.	Solid and powder form. Has hexagonal crystalline structure similar to graphite.	Vacuum tube separators; dielectric applications; electrical insulators; chemical equipment parts; molten metal pump parts; combustion chamber liners; melting crucibles; thermocouple protection tubes; mold release agents; gaskets; seals; rupture discs.
KT SILICON CARBIDE Extremely hard, self-bonded impermeable ceramic for use up to 4000 F.	Very hard; negligible permeability; exceptional abrasion and corrosion resistance; working temperature to 4200 F in inert atmosphere, to 3000 F in oxidizing atmosphere; high modulus of elasticity, flexural strength, compressive strength, thermal conductivity; low thermal expansion; excellent resistance to thermal shock.	Standard ceramic forming techniques can produce large intricate shapes to .007" tolerance on unground surfaces and to .001" on ground surfaces. Diamond grinding necessary for finish machining, can produce very high surface finish (5 micro-inches).	Solid form.	Wear-resistant parts; crucibles; heat exchanger parts; valves for corrosives; pipe and fittings; nuclear reactor structural parts; rocket nozzles; nose cones; leading edges.
FIBERFRAX® A fibrous insulation medium above the practicable temp range of mineral wool, glass & asbestos.	Melting point over 3000 F; maximum use temp 2300 F; low thermal conductivity; castable forms exhibit exceptional thermal shock resistance.	Extremely diverse fabricating possibilities due to wide variety of forms available.	Bulk; long & short staple fiber; batts; board; paper; blocks; castable compositions; molded shapes; roving; yarn; wicking; rope; tape; cloth; braid.	Thermal, acoustical and electrical insulation; high temperature gas filters; gaskets; packings; liners for aluminum pouring troughs; vacuum outgassing of reactive metals; protective cushion in honeycomb brazing; protective coatings for metals and graphite.
REFRAX® Silicon-nitride-bonded silicon carbide.	Average bulk density: 2.87; porosity: 7.9%; thermal conductivity @ 2200 F: 113.5 Btu; modulus of rupture @ 1350 C: 5640; excellent abrasion resistance; very high relative resistance to spalling; not wet by molten silver, copper or aluminum; good thermal shock resistance.	Can be formed into complex shapes with tolerances as low as .005"/in. possible without finish grinding. For closer tolerances, lap or grind with diamond abrasives; drill or bore with ultrasonic methods.	Brick and shapes in many instances resembling metal in characteristics.	Brazing fixtures; pumps and pump parts for aluminum and other nonferrous metals; burner tips; nozzles and blocks; cyclone-type classifier parts exposed to abrasive materials suspended in liquid and gas carriers; acid spray nozzles.
STUPALOX® A ceramic oxide cutting tool material.	Composition: aluminum oxide; hardness Rockwell "A": 92; compressive strength: to 450,000 psi; transverse rupture strength: to 100,000 psi.	Diamond Grinding. Lapping.	All Standard Tool Shapes. Special Die and gage shapes.	Cutting tools; wear parts; dies.

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Where conventional materials fail . . . call on

CARBORUNDUM

REGISTERED TRADEMARK

Industry Again Cries Engineering Shortage Blues

NEW YORK—An engineering shortage once again rears its hungry head. Within the past few months the tone of the employment market has changed markedly. Not all areas or engineer specialties are feeling it.

One gage of trends, the US Employment Service report on inter-area job openings, shows that 4419 engineering positions could not be filled locally in mid-October. This is 1500 more than their count showed in mid-July or last October. By engineering specialty, the USES showed 1788 openings for electrical engineers, 1577 for mechanical and 822 for civil. These fragmentary statistics reflect conditions in 41 key labor market areas.

A large number of the unfilled openings show in western missile and aircraft states, the USES says. And this is borne out by surveys of employers in the area. One West Coast personnel officer observed that last year at this time he had "unsolicited applicants—men walking in the door to fill out applications for engineering jobs even though we weren't advertising." Now, he says, it's hard to get people to come out to "talk employment."

Another observed that his company's employment ads are now drawing, "a high percentage of floaters and people who are trying to upgrade their job classifications more than their experience justifies by switching from one company to another."

SPECIALTY FIELDS HARDEST HIT

The shortage now is especially acute for people with special experience—and sometimes employers ask the impossible. "The biggest recruiting problem in the Los Angeles area," one aircraft personnel head stated, "is finding people with 10 years experience in fields that are only four years old."

In the New York area requests for engineers have picked up substantially in the past 30 days, a source at the personnel service for the engineering societies states. No qualified engineers, he says, are waiting around for jobs now, except possibly those who are over age. Requests for engineers are coming in heavily from industry, especially for electronics specialists. Requests for engineers to work overseas are also plentiful—about 90% of these for construction jobs.

But domestically, he says construction engineers are having a harder time. For some reason the highway program has not yet been felt. Consultants also are not hiring at present. He attributes this to the fact that industry is not building new plants or power stations as rapidly as they were a few years ago. The consultants recession is especially hard on older applicants over 55 who can get jobs with consultants long after industry refuses to hire them.

DETROIT HAS SURPLUS

Detroit in contrast to the national picture has a surplus of engineers. Employment is so slow, in fact, that the personnel service of the Engineering societies will close up shop in November. Auto companies are letting some engineers go now that the new models are out, and some 40 companies have left the area recently taking employment opportunities with them. Observers see few indications that the situation will reverse in the near future.

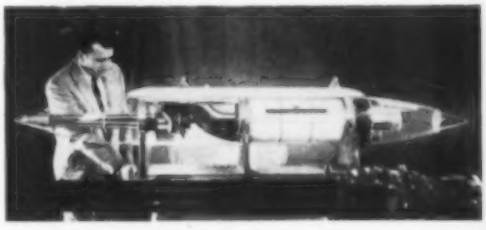
Looking ahead, the employment picture continues to pull conflicting views. The National Science Foundation and US Office of Education forecast continuing shortage. For 1965 they anticipate some 1,250,000 engineering jobs with 686,000 engineering degree holders to fill them. In 1960, they anticipate 950,000 engineering jobs and 526,000 engineers holding BS degrees.

On the other hand, a study by I. Hirsch, W. Milwitt, W. J. Oakes and R. A. Pelton estimates that the shortage of scientific manpower (both scientists and engineers) totaled 30,000 in 1956 and will become more acute until it reaches 70,000 in 1965. At that point, they say the trend will reverse becoming a surplus by 1971. They assume the nation's output of goods and services will run about $525 billion in 1965 and $600 billion in 1971. They further assume defense spending will account for about as much of our output as it does now and the products industry makes will require about the same engineering manhours they do today.

Their most startling assumption is that engineers will be used about as efficiently as they are now. Yet they assert, on the basis of a survey, that professional workers are now about 10% effective.

Meanwhile, personnel managers are bracing for whatever develops. A scarcity of qualified workers in nuclear propulsion, infra-red, and intelligence systems they say is expected because the fields are new. But shortages in less exotic disciplines—electronics for example—are alarming. Industries with heavy requirements in these areas are again activating college recruiting programs with some new twists. Industry is adding up the cost of last year's layoffs—the dollars it put into recruiting, moving, and training a man only to let him go. Many recruiters are now emphasizing opportunities for intra-company transfers and advanced training programs to upgrade newly hired graduates.

A 7.62-mm Vulcan aircraft cannon . . .
shown here in mockup stage is the latest offspring of the series begun in 1946 for use on fighter planes and other light aircraft. Designed by GE, the weapon is based on the Gatling-gun principle and fires 6,000 to 10,000 rounds from eight rotating barrels. Its linkless ammunition feed does away with conventional belted ammunition, and hence the whipping action that accompanies it. The new Vulcan is smaller than its 20-mm predecessor, weighing only 185 lb and fitting into a bullet-shaped container just 90 in. long with 10-in. dia.



Multifuel Engines: Army Still Major Customer

BALTIMORE—While the vehicles of the future may be powered gas turbines, free-piston engines or nuclear reactors, today's Army is betting on the conventional piston engine for its future mobility. And for a maximum improvement in economy, the Army is looking at the diesel-type, multifuel engine. These comments were made by E. F. Blackburne, and Capt. R. H. Sawyer of the Army's Tank Automotive Command at a Multifuel Engine Symposium at the SAE National Transportation and Diesel Engine Meetings.

"Compression-ignition engines which will run on gasoline," they said, "will eventually run on fuels of higher octane. An engine that will operate over a workable fuel spectrum will permit our armed forces to fight anywhere in the world on fuels shipped from the US, its allied producing areas, and on the fuels available in the area of action itself."

The Army's requirements, for a multifuel engine are currently these:

1. Operate on any fuel from the 83/91 gasoline, the kerosenes, and down to a point in one middle-distillate range which is governed by the viscosity and pour point.

2. Operate on any mixture of these fuels without manual adjustment.

3. Be capable of starting and operating without off-engine auxiliary equipment from −25F to 115F.

4. Develop full engine power output on any fuel (proportional only to the specific heat content of the fuel used.)

5. Weigh no more than 6 lb per hp for the engine and cooling package.

According to Blackburne and Sawyer, the basic multifuel problem is combustion control. Another difficulty is in getting satisfactory durability at high engine output on gasoline. Still another is erratic combustion at light load and idle when gasoline is used. At present, Ordnance is studying 4-stroke and 2-stroke compression-ignition engines. Army feels that all multifuel engines that have been developed to date here and abroad, are too large and heavy. Blackburne and Sawyer said, "Our goal for the immediate future is multifuel engines as light or lighter than the mono-fuel engines they will replace."

H. S. Ford, Jr. and E. J. Godlew of the Detroit Diesel Engine Div. of General Motors said that to get full engine output with the GM model 71 engines it is only necessary to increase the injector capacity to make up for the heating losses, injector output and thermal efficiency. They claim that with minor changes in the fuel system, the 71 engine can be operated satisfactorily on 80 octane gasoline and aviation turbine fuels as well as normal diesel oils.

Dr. Herbert Haas, chief engineer of the Diesel Div. of Continental Aviation & Engineering Corp. says that every compression-ignition engine is inherently a multifuel engine in the broad sense of the word. So the military's desire for a multifuel engine should actually be the use of high octane gasoline in a compression-ignition engine. This can be considered as the main problem to solve.

NO COMMERCIAL DEMAND

William Lenzi of International Harvester Co. said that commercial demands for a multifuel engine have been non-existent, but IH has made tests on its pre-combustion chamber engines for some time to determine the inherent performance characteristics of the basic design. Tests showed that these engines, with some revisions, can be used as multifuel engines in their present speed ranges up to outputs of 95 bmep.

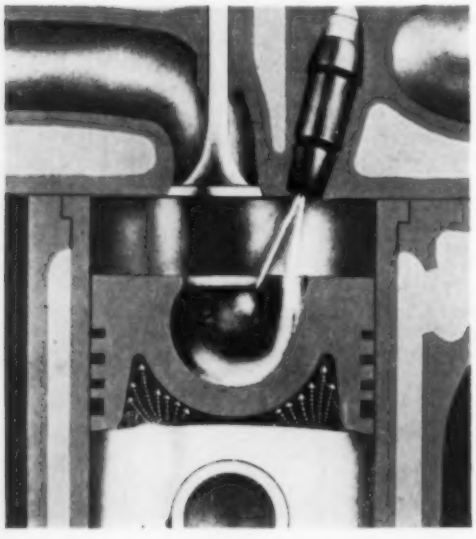
Bruno Loeffler, consulting engineer, Mack Trucks, Inc. feels that the scope of a multifuel engine should be extended to the use of crude oils taken from the wells to permit the Army to "live off the land." Operating on kerosene JP-4, lube oil, or crude is not a problem today, he said. He repeated Haas' claim that using gasoline in a diesel engine is the big problem. Testing a diesel engine with JP-4 fuel, the power loss was from 11-15%. Gasoline knocked badly and would not operate at top speed. Compression ratio was 16.6:1. Tests were made at 75% gasoline-25% lube oil and on a 50-50 ratio.

CONTROLLED COMBUSTION

Adolf Lurken of the Army's Engineer R & D Labs, says that a multi-fuel engine needs a controlled combustion system, i.e., a soft combustion with a rate of pressure rise between 30 and 100 psi per deg crank angle. Tests have shown that the real multifuel systems carry loads of 170 psi when supercharged. They will do more with intercooling, Lurken says.

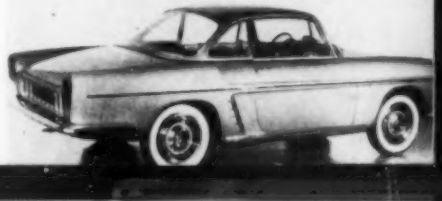
Double fuel injection . . .

is key to French Berliet multifuel engine. Five percent of the charge, directed at the center of the combustion chamber, triggers the combustion. Remaining 95% is sprayed tangentially on the hot walls of the chamber, volatilizing progressively for smooth combustion, according to Berliet. Cyclonic air flow, set up in the air intake passages, promotes complete burnup of the fuel. Berliet says engine will be available with from 2 to 12 cylinders with outputs from 60 to 650 hp.



Renault with a Gia body . . .

made a style splash at the recent Paris Auto Show. The new body has three versions: closed coupe; convertible; convertible with detachable hardtop. Called the "Floride," the car is 10 in. longer than Renault's Dauphine, but carries the Dauphine engine, transmission and sus-



Rocket-assisted personnel ejection . . .
catapult (RAPEC) viewed in 3 stages. (1) still-seated pilot is ejected from aircraft. (2) pilot and seat part company (3) chute automatically deployed carries pilot to ground.

Survival seat . . .
for the X-15 is equipped with arm guards that once ejection levers are pulled will pivot elbow rests inward so that pilot's elbows will be tucked to his sides. Handholds in the ends of the arm-guards provide pilot with stability, prevent flailing during ejection. Bars at the foot-rests also swing inward to hold pilot's legs in place. Separation points where pilot and seat part company following ejection is located at the large horizontal retaining bolt mounted below the arm-rest pivot points. Stabilizing "wings" and fins outpop when seat is ejected from the cockpit.

Navy, Air Force Develop Pilot-ejection Systems

Los Angeles—Two systems for ejecting pilots from superspeed aircraft—one developed by the Navy, the other by the Air Force—are rated by their designers as safer than the jumps made by a paratrooper.

The Air Force system devised by North American Aviation Corp is for the X-15—the 3500-mph new rocket plane reportedly capable of returning man from an orbiting trip around the earth. Here, the "survival seat" has stabilizing fins that keep the pilot upright after he is hurled from the plane.

The ejection sequence is as follows. When the pilot pulls the eject levers, they swing up and in to reinforce the safety belt. Padded armrests move in, clamping the elbows close to the body to prevent them from being ripped off by the high air pressure. When the canopy is blasted off, the seat is hurled upwards and the stabilizing fins fall into a horizontal position to keep the seat in a gliding attitude. A front blast deflector, extending out on a beam from beneath the seat, protects the pilot from the effects of high-speed air. He continues to receive oxygen from tanks strapped to his back.

At a preset altitude a gas cartridge sends the parachute into its fully opened position. The chute is standard–just prior to its being fully opened, explosive bolts release clamps holding pilot's arms, legs and body. The space suit is equipped to protect pilot from all types of weather.

NAVY DESIGNS RAPEC

Navy's system developed at China Lake Navy Ordnance Training Station is called the Rocket-assisted-personnel ejection catapult (RAPEC) and can be applied with minimum modification to standard seats in standard aircraft (X-15's seat catapult is designed only for that craft and seat configuration is styled specifically for the six pilots who'll fly it). It has sufficient thrust to boost a 200-lb pilot to safe chute-opening height (225 ft).

RAPEC operates in 2 steps. First, the small propellant charge lifts the pilot-seat out of the plane. Then the rocket propellant charge ignites, and pushes the seat to the desired altitude. At this point, seat and pilot part company; after this the chute opens.

To operate the RAPEC, the pilot jettisons the canopy, pulls his protective face-curtain below chin level. This automatically fires the percussion primer which fires the internal gas-generator cartridge at the bottom of the rocket-launching tube, launching the rocket and lifting the seat up and out of its retaining rails.

Just after the rocket is launched, an attached wire opens a valve to let hot gases reach and ignite the propellant (high-energy X-12, a double-based, nitro-cellulose-nitroglycerine, extruded-grain, said to be unaffected by temperatures in the −65 to 165 F range).

SLANT SEAT FOR STABILITY

Though no fins or other devices are used, the seat goes up and forward at about a 45° angle from direction of plane travel. Added forward thrust gives the pilot time and space necessary to avoid tail of plane.

At rocket burn-out, an automatic

---

pension system—is expected to cost about $500 more than the Dauphine. Also announced at the show was a Peugeot 403 sedan with a 48-hp diesel, but not available until late next year. Although adding $360 to the price of the car, it will cut fuel costs greatly in France, where gasoline costs almost a dollar a gallon.

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cartridge with a delay train–fired as soon as the seat moves–triggers a lap-belt switch to open ½ sec after eject is started. Simultaneously, a bladder underneath and to the rear of the pilot inflates–separating seat and man while both are rising. Another cartridge with a delay train then opens the chute 1 sec later unless pilot is at high altitude, in which case chute deployment is delayed by a built-in barographic device. The RAPEC is not designed to cope specifically with supersonic bailout.

Douglas Aircraft is expected to be the first aircraft maker to put the device to commercial use; most probably in its A4D and F4D craft.

Industrial Designers Have More than Work Cut Out for Them

BEDFORD SPRINGS, PENNA.—"The doctor protects the health of his patients, the lawyer seeks justice for his clients . . . both are clearly definable goals. Only the designer is told that he must create beautiful, functional products . . . but first of all, they must sell."

These remarks by Sydney J. Harris, columnist of the *Chicago Daily News*, keynoted the Oct 18-21 annual meeting of the American Society of Industrial Designers. Theme of the sessions was "Responsibility and Directions," with emphasis on creativity and future.

Expanding the theme, George D. Culler, associate director of the San Francisco Museum of Art, declared there is no single, right design. Said he, "The postulation that there is one right solution is a very inhibiting factor in design . . . Humanity is not a product to be cased in houses, cars, or offices like we case beer." Culler also pointed out that when the designer has come to understand fully the nature and characteristics of the material he uses, the user participates, although perhaps unconsciously, in the same reactions the designer experienced himself. "Like other work," said Culler, "design is an activity carried out by people together, with the creator and the user sharing similar experiences and reactions."

"Spiritual digestion" is a need of our mechanistic world, in the opinion of Enrico Peressutti, famed designer-architect of Milan and vice-president

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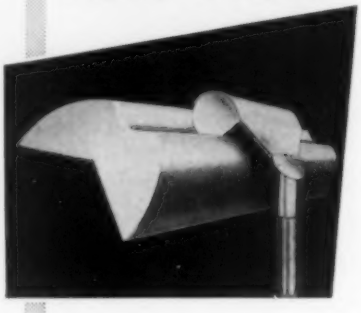

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of the International Council of Societies of Industrial Designers. He stressed that the language of our civilization can be misspoken by false design. "In order to drive our daily 50 or 100 miles," he said, "4-wheel sophisticated missiles or space ships are distributed annually." Or again, when an Italian designer showed Peressutti a jet-age, streamlined café expresso machine, his comment was, "How many mph does it make?"

Saul Bass, West Coast designer and consultant, who spoke on the same panel, added this point: "Industry would like to have all the advantages of creativity with none of the headaches . . . General creative development is not only desirable but essential in our civilization . . . The creative personality is essentially nonconforming . . ." He went on to point out that creativity is impossible if conformity is also a requirement.

Creativity and related problems was the subject of an entire separate session on the convention's last day. Two psychologists gave their papers on the subject in the morning. Then came a presentation by Dr. J. H. McPherson, psychologist with Dow Chemical Co, and his wife also a psychologist, based on studies from many sources of creative process. It concluded with an interesting approach: "What Do the Wives Think?" A panel of the wives of four leading industrial designers took part. The McPhersons described over 30 typical behaviorisms of creative people, which will be presented shortly in PRODUCT ENGINEERING.

Elected for the coming year by the ASID membership: were Donald L. McFarland, president (Small Appliances Dept, General Electric Co); Richard S. Latham, vice-president (Latham, Tyler and Jensen, Chicago); William C. Renwick, secretary, (consultant, New York City); Kenneth Van Dyck, treasurer (consultant, Westport, Conn.)

Heard at the AIEE Machine-tool Conclave:

HARTFORD—Last week's issue of PRODUCT ENGINEERING carried the early reports on papers and discussion at the AIEE Machine Tool Conference. Here are further developments, as reported by Editor Frank Yeaple.

Concerning the future of actuators and transducers for micro-positioning, it was learned that a machine tool

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WRITE FOR ENGINEERING BULLETIN RC-11A

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THE PERMANENT MAGNETS THAT ARE REALLY PERMANENT

company, working on a project for the Atomic Energy Commission, will announce a new machine with a 40 micro-inch feedback accuracy.

Design of Titan ICBM (Martin Co) took advantage of several new manufacturing techniques. C. L. Phillips of Denver Division cites Heliarc welding procedure for 2014 Aluminum alloy, stretching operation on ¾-million-lb press, and chemical milling. Chill-blocks and heavy heat-conducting clamps helped solve welding problem. Other ideas proposed (for future designs) are: extruded panel sections to reduce need for fabrication and machining; printed circuits on frame structure of missile to save on conduit; use of beryllium for valve parts.

Boeing Airplane Co, Wichita Division, has had six continuous-path, numerically-controlled machines in operation for over one year. Spokesman, W. B. Beeby—company's numerical control can cut costs for some milling operations by 80%, lead times by 85% and machining times by 90%. Actual design of wing sections has been influenced by proven ability of numerically controlled machine tools to easily and accurately cut tapered skins. Only problems (besides initial higher cost) seem to be in education: management must be convinced; and operators, maintenance men must be taught. Now his company insists that all new machine tools be numerically controlled unless good justification for conventional types can be given.

Cryogenics—the science of low temperature—may some day invade the industrial computer field, according to John Morin, Concord Control Corporation. He has participated in experiments at MIT that tried to prove feasibility.

Cryogenic computers operate in an atmosphere of liquid helium at a temperature lower than minus 455F. All materials develop new and radical electrical properties here, and can be made to have resistances so low that they are for all practical purposes, zero. Small magnetic fields introduced across conductors can vary the resistance quickly from zero to a substantial positive amount, providing the off-on logic needed in a computer.

Several companies are already experimenting with miniature computers operating in liquid-helium—they prove to be many times smaller in size, even including the refrigeration equipment that goes with it.

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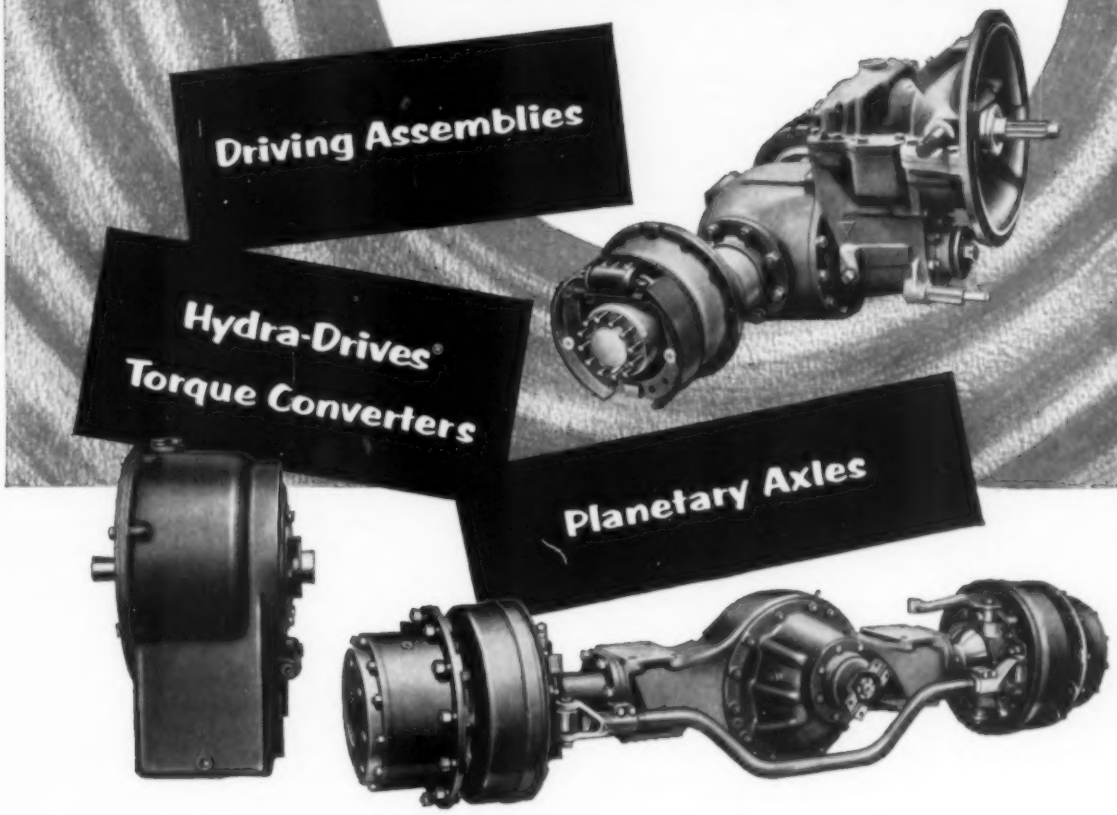

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MAKING MONEY WITH PATENTS

A Rebuttal . . . .
In the July 28 issue, Davidlee Von Ludwig attacked the U S patent system: "The Little Man Can't Protect His Patents!" Letters from inventors (praising our courage to print such an article) and from attorneys (damning our irresponsibility in printing such an article) proved to our satisfaction that the subject needed the attention of these pages.

The September 22 issue carried the letters and now we have a full-scale rebuttal of Mr. Von Ludwig's thesis by a practicing attorney. Mr. Crooks, formerly with Arthur D. Little, Inc, and with a Boston law firm, handles patent and general law matters of McMillan Industrial Corp. He is an electrical engineer and a member of the Bars of Massachusetts, New York and the District of Columbia.

ROBERT G CROOKS *Resident Counsel*
McMillan Industrial Corp, Ipswich, Mass.

Criticism of our patent system is not new. Weaknesses have been intensively explored for at least 20 years by many thoughtful people, both within the Patent Office and outside it. In 1952, the Congress enacted a codification of the patent law which improved and clarified it in many respects. The Committee on the Judiciary of the United States Senate is presently engaged in a searching study directed toward the further improvement of the patent law.

The problem is how do you separate patentable inventions from those developments unworthy of protection? Just how good must an invention be to be worthy of a valid patent? Although the patent law gives a general guide for the determination of patentability, and many auxiliary tests have been developed to help apply this general guide, the question of patentability must often be answered by an individual, in the Patent Office or in the courts. And whenever a question is answered by personal judgment, differences of opinion are inevitable. Hence, it sometimes happens that an invention, awarded a patent by the Patent Office, is later held by a court to be unworthy of patent protection. The patent is then nullified, at least in part, by the court.

Every inventor should realize that, although he is successful in getting a patent on his invention, there is always a chance that a court having the patent before it will hold the patent to be invalid.

When an inventor discloses an invention to his patent attorney, he would do well to get advice on whether to spend the money and effort to get a patent in the first place. He should not ask the attorney, "Can you get me a patent on this invention?" That is a challenge to his ability as an attorney. But rather, "Under the circumstances, do you feel that it would be wise to invest time and money in patent protection for this device?"

The inventor should explain just what the circumstances are. Why does he feel that his invention is significant? Why does he want a patent and what does he expect to do with it? Has he analyzed the potential market for the invention? Does he expect to have financial support for promotion of the invention? And most important of all, what reason does he have to believe that the invention is really new?

FIRST, NOVELTY

The patent law requires that patents be granted only on new inventions. Even though the inventor believes his invention is new, he and his attorney should usually make a preliminary patent search to locate any patented prior art. Such a search is much less expensive than filing a patent application and will often show that filing would be a waste of money. The inventor can save money by himself making a thorough literature search, using the *Engineering Index* and the *Industrial Arts Index* as points of entry.

NEXT, SIMPLICITY

Inventions whose novel features can be stated in a few words are often the most significant. However, "simple" inventions, in order to be new and validly patentable, must often be rather fundamental. Therefore, the patents that get the most respect are likely to be those covering inventions that are significant advances in the art and that can be very simply stated. Every limitation in a patent claim is an invitation to evasion of the claim by avoidance of that particular limitation.

EMPLOYER VS EMPLOYE

Before any money is spent on patent protection, the inventor should assure himself that he has the legal right to exploit his invention. If he agreed that all inventions would belong to his employer, the latter has the right to exploit the invention, and the inventor will generally do well to cooperate to assure most effective use of the invention. Although the majority of employers do not pay royalties as such, productive inventor-employes generally get recognition in some form, whether in salary, promotion, bonus or otherwise. These forms of recognition minimize the bookkeeping complications and jealousies which would inevitably accompany a royalty system for rewarding inventor-employes.

If the inventor has used his employer's time or facilities in developing the invention, the employer is likely to have a shop right to use the invention for his own purposes, whether or not the employe has expressly agreed to grant such a shop right.

If an inventor-employe was hired for the purpose of making inventions, such inventions generally belong to the employer, at least if the inventions are in the field

IS TOUGH –

BUT NOT IMPOSSIBLE

in which the inventor was hired to work. Of course, many employers are willing to release to their inventor-employes all rights to inventions not falling in areas of interest to the employer.

Note that an inventor is generally obligated not to compete with his employer as long as their relationship continues (for a recent court decision covering company "secrets" in general, see *PE*—Aug. 18, *p* 23). Also, the employer may have definite views as to the amount of time an employe should devote to the exploitation of his own private projects.

THE PATENT APPLICATION

If the inventor and his attorney decide that the invention is new, significant, reasonably fundamental, commercially promising and that the inventor owns it, the next step is usually to have the attorney file a patent application. Although sufficient expenditure to insure the preparation of a good application should be authorized, the amount of such expenditure will generally not be outrageous.

The first Patent Office action on the application is usually a rejection. However, if the "references" cited by the Patent Office are not too surprising in view of the prior art turned up during the preliminary search, it is generally worthwhile to persevere in prosecution of the application. When one or more claims in the application have been allowed by the Patent Office, the inventor and his attorney are likely to have a pretty good idea of what will be the scope of the patent to be issued on the application.

EXPLOITATION

This may be the time to begin steps toward commercialization of the invention, if such steps have not already been undertaken. Allowance of patent claims by the Patent Office, while not binding, is tangible evidence that a new invention exists, and the scope of the allowed claims is some indication of the nature of the patent monopoly which can be obtained.

With an official record of his conception of the invention, the inventor can feel safer about disclosing his invention to those who might give him assistance and suggestions for its exploitation. Every effort should be made to ensure that the evaluation of the invention prior to filing the patent application is still correct. Was the commercial market properly evaluated? Does the invention still appear to be a significant step forward? Have all the conceivable uses of the invention been canvassed?

If the inventor decides to submit his invention to a corporation, he should choose this company carefully. He should prepare himself to show, with the aid of data previously accumulated, how his invention will help to solve a problem he knows the corporation possesses, or how use of the invention would increase sales or profits. The inventor may find a more receptive audience with a small corporation than with a big one because the latter may consider itself capable of evolving all its own new developments. Remember that many large corporations are constantly peppered with ideas and regard them as something of a nuisance.

Also, remember that many large corporations have been victimized by legal actions at the hands of unscrupulous or uninformed inventors, and have consequently developed an understandably negative attitude toward submitted ideas. In order to gain acceptance, an idea submitted from outside a company must often be of much higher quality than an acceptable idea generated within the company. Selling an idea or an invention will demand all the inventor's salesmanship, shrewdness and tact. It is important to reach the company official whose activity will be most benefited by use of the invention. If that official can be sold, he will sponsor selling the idea to the others in the company.

WHAT ABOUT INFRINGERS?

There are some unscrupulous people who see nothing wrong in adopting an idea submitted to them and claiming credit for it as their own. However reprehensible such conduct may be, an invention disclosed to a person or company, unless disclosed in confidence or under some agreement for payment, may legally be used by that person or company until the issuance of a patent on the invention. This legal freedom exists despite any corresponding moral obligation that the inventor may regard as prevailing. The allowance of satisfactory claims in the inventor's patent application then becomes very important as a means of demonstrating that any such unauthorized use will be short-lived.

The inventor will be well advised to keep secret the serial number and filing date of his patent application, at least until negotiations concerning the invention reach an advanced stage. But while care should be taken to avoid being cheated by a company, the hardest problem, and the one requiring the most skill, is that of convincing the company to buy the invention or take a license.

What if a company decides that it will infringe patent rights submitted to it? First of all, remember that the company might try this because of some justifiable feeling that the patent rights will not be found valid. The patent law is full of technicalities, many of which can invalidate patent rights. There are good reasons for the existence of most of these technicalities, and any person or company is free to take advantage of them. Nobody wants to pay royalties on an invalid patent.

If officials of a company make it plain that they regard a submitted patent as valid but that they choose to infringe it anyway on the theory that the inventor can

not afford to sue for infringement, the inventor should keep careful records of persons, witnesses, and documents evidencing the admission of infringement and validity. These records may be helpful in securing treble damages for willful infringement of the patent by the company.

If there is a clear case of infringement, where will the money come from to prosecute the infringer? As Mr. Von Ludwig pointed out, patent litigation is expensive, often even more expensive than other types. If carried through trial, the litigation will probably cost tens of thousands of dollars. If an infringer knows that an inventor is not able to finance his case through trial, the infringer will be inclined to stretch out the case, making it as expensive as possible for the inventor in the hope that the inventor will have to quit before being able to get a decision in his favor.

If an infringer knows that an inventor *can* finance a trial, the infringer may be willing to settle the case before his own expenses mount too high. So an inventor must somehow have at his disposal sufficient financial backing to get through trial of one infringement action. This backing can come from the sources which financed the venture in the first place: Money in reserve for such a trial may have to be regarded as one of the capital facilities to be held available while the invention is exploited.

The inventor must be able to demonstrate his likelihood of success convincingly enough to enlist the aid of his friends, of venture-capital sources, or banks. Occasionally, lawyers are willing to contribute their services toward the purchase of a share in a business or to accept compensation on a contingent-fee basis. However, lawyers operate under canons of ethics which forbid them to "purchase any interest in the subject matter of a litigation."

If an inventor can realize the proceeds of one successfully concluded infringement action, he is then in a position to cope with other infringers. They are likely to settle with him rather than incur excessive legal expenses. Alternatively, the inventor may find it advantageous to sell his patented invention to one of the infringers. Such a sale can be negotiated much more easily after the successful litigation of an issued patent than before.

Mr. Von Ludwig has suggested changing the law so patent rights would be enforced by the Attorney General's office. He feels this would be analogous to the enforcement of criminal law by the public prosecutors.

In asking also that patents should be made "properties," Mr. Von Ludwig seems to assume that personal rights in "properties" are protected by the Attorney General, and that if patent rights were made "properties" they, too, would be protected by the government.

As a matter of fact, the patent law does already define patents as having the attributes of personal property. And a patentee goes about protecting his invention in the same way he would go about protecting his rights in other personal property—namely, by civil action. Although it is true that the public prosecutor invokes the criminal law for *punishment* of one who steals property, it may still be necessary for the victim of such a theft to bring a *civil* action for damages occasioned by the theft—if he thinks the thief can pay them.

However, as we have stated, patent rights are nearly always somewhat conjectural in nature, at least by contrast with the rules of the criminal law. The defendant in a patent-infringement case is much more likely to be acting in good faith than is the defendant in a robbery case. It would be a great hardship to manufacturers if they were required to steer clear of the rights represented by the half million patents now in force, at peril of criminal action. By leaving the enforcement of patent rights to *civil* actions initiated by the owners of those rights, we gain the benefit of a natural process of selection—the owners of worthless patent rights simply make no attempt to enforce them because the likelihood of success would be so small. However, the owners of more substantial patents are free to enforce them as they choose.

With regard to the patent-enforcement process in Germany, which Mr. Von Ludwig feels is more satisfactory than that in this country, it is true that the courts in some European countries undertake much of the burden of investigation of the cases they try. However, it can hardly be said of the German patent system that "the Government defends from theft or infringement." It is an axiom of our Anglo-American legal system that nobody has more incentive to uncover the significant facts in a law suit than the parties to the suit. Therefore the main burden of discovering and proving these significant facts generally falls upon the parties themselves, whether the suit is a patent case or any other kind of legal action.

THEREFORE, TO PROTECT YOURSELF . . .

A "little man" *can* patent and successfully exploit inventions, either as a member of a corporate team or on his own account. However, he must go about it in the right way. Here are the essentials:

1. The invention must be a good one. It must be a significant step forward, not just an obvious improvement.

2. The invention must be new and must satisfy the requirements of novelty established by the patent law.

3. The invention must have commercial significance in that it can be used in volume by people who will be willing and able to pay hard cash to have the benefit of its advantages.

4. The invention should preferably be relatively simple so that its novel features can be summarized in a few words and so that adequate legal protection can readily be obtained.

5. The exploiter of the invention must have the legal right to exploit it.

6. The invention must be attractively presented, both to the supplier of capital for the venture and to the prospective user or users.

7. Care must be taken in negotiations with all persons concerned. But care is no more important than proof of the existence of a problem which can be solved by the invention, and an attractive presentation of the invention as the solution. Above all, avoid a chip-on-shoulder approach to a prospective customer or licensee.

8. Know your invention. Know your patent rights and enforce them firmly. Have access to a certain amount of capital or legal services for that purpose. ■

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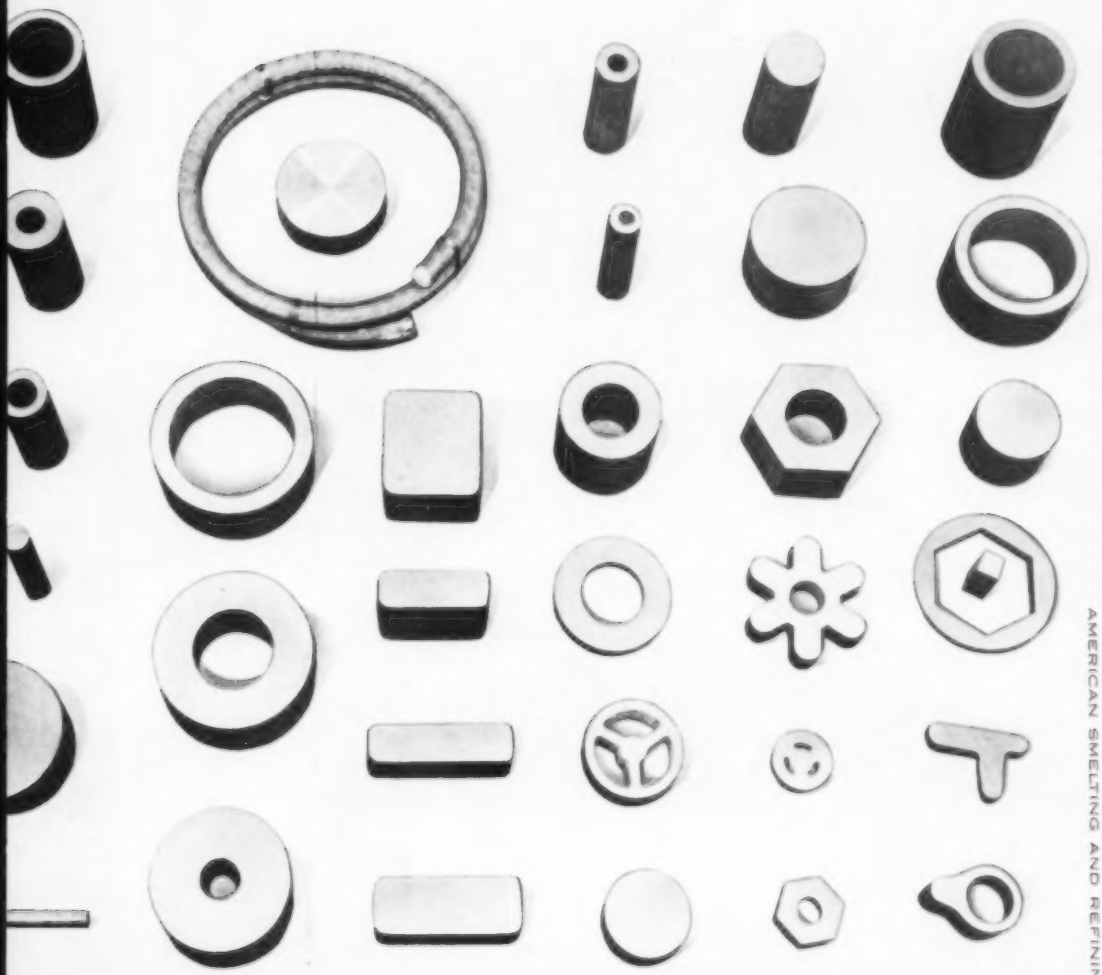
In continuous lengths: the bronze casting you want in the shape you want! The advantages of custom-shapes in long lengths instead of individual castings. The uniformity and machinability of bronze alloys with no hard or soft spots: no sand, dirt, or dross to dull tools or reduce cutting speeds. The superior physical characteristics of continuous cast bronzes: impact, tensile, and yield strength, and hardness, improved as much as 100% over the same alloys cast by other methods. Asarco will custom cast practically all standard tin-bronze alloys in the shapes, lengths and diameters you need. Asarcon 773 (SAE 660), general purpose bearing bronze, is available from stock in 260 standard sizes, solids and tubes. Check with your local Asarco distributor or write: Continuous-Cast Products Dept., American Smelting and Refining Company, Barber, N. J., Kingwell Bros., Ltd., 457 Minna St., San Francisco. In Canada: Federated Metals Canada, Ltd., Toronto and Montreal.

CONTINUOUS-CAST DEPARTMENT OF



ASARCO

AMERICAN SMELTING AND REFINING COMPANY

TRENDS

SELF-WINDING WRISTWATCH DESIGN

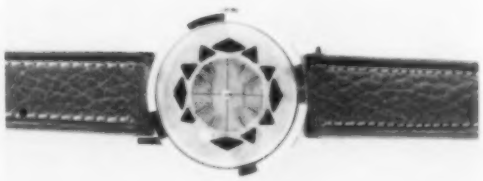
The principle of the automatic watch was discovered in 1777 by Louis Perrelet. Ever since 1931, when the automatic wristwatch invented by John Harwood (with rectangular case, at far left) first came on the market, there has been a constant search for greater compactness—particularly thinness.

Until recently, the oscillating weight that wound the watch spring was always centrally located (sketch at top, far left). At first these rotors had only a limited arc of movement and wound the spring only when moving in one direction. Excessive bearing wear and, with some wearers, inadequate winding action resulted. Later the rotor was made free-moving through the full 360°, and still later it became possible to employ both directions of movement. This was accomplished by a whole family of rectifying mechanisms, including gear-wheel rockers, eccentric drives, opposed sets of gear wheels, a wig-wag type of pinions, ball-bearing and pawl arrangements, a clutch based on ruby rollers.

Early this year a completely new approach to the design and placement of the rotor was introduced. In this watch (at left), the winding mechanism is also based on a rotor, but it is planetary and built into a recess in the movement itself (sketch at top). This means that still thinner watches are possible, but with greater height for working parts. This rotor is ball-bearing-mounted. A movable reverser wheel provides winding in both directions. And for the first time, the self-winding mechanism is automatically disconnected by a clutch whenever manual winding is required. Watches are shown actual size.

Illuminated wristwatch has its own battery and minute bulb.

White disk rotates into apertures to mark hours, small black marker on inner disk marks minutes.

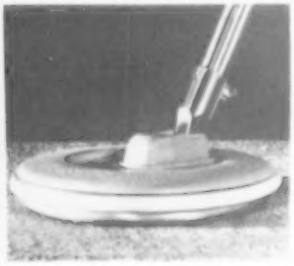


At left, another example of a thin, self-winding watch. At right, a study in dial extremes. Watch is for navigators, and can be used to calculate position, destination arrival, fuel consumption, speed, rate of descent or climb. Also records elapsed time.

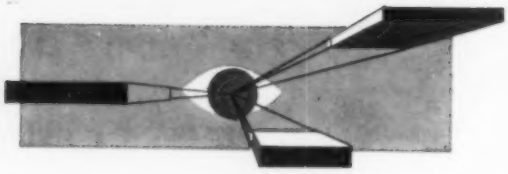
n appearance design.

FARM TRACTOR is made in several horsepower models, with 6 forward, 2 reverse speeds. Designed by Raymond Loewy Associates Inc, Chicago, for Cockshutt Farm Equipment Ltd.

SWEDISH-DESIGNED CARPET SWEEPER has four freely rolling brushes positioned in slots in base. Brushes protrude and rotate as disk is pushed and pulled across carpeting. As produced abroad sweeper had 21 components made mainly of sheet metal. As redesigned, same assembly is composed of 6 die-castings, plus some fastenings. Made by Interstate Precision Products Corp., Anaheim, calif.



OPEN-BACK PANEL TRUCK was exhibited at recent Paris, France, auto show. Used as sound trucks at fairs, trade shows and for publicity by *Le Figaro*, famous Paris newspaper. Produced by Establishments Arnault, Garches, Seine, France, on 3-ton Renault truck chassis.



POINTS

THE QUESTION: ***"How Much Should a Company Automate?"***

HORACE D GILBERT
President
Miniature Precision Bearings Inc

"Automation, like marriage . . .

should not be entered into lightly. There has been a great deal of glamor attached to the 'automation' concept, tending to endow it with magical profit-making capabilities. Automation in truth, however, is merely sound modernization of equipment and, therefore, subject to the same rules. By this, I mean that one should apply the same yardsticks to the automation of a complicated assembly line as one does to the improvement of a simple machine-loading device.

"The questions one should ask before plunging into automation are these: How much will it cost? How soon can these costs be amortized by savings? Will automation improve quality or have other valuable concrete or intangible advantages? Also, more broadly, does this improvement have application in other fields? Do we have a patent position and shall we plan to license use of the patent?

"Automation is putting into practice the results of R & D and is essential to any company planning a successful future. The amount of automation to be planned for each company must be determined by careful consideration of the short- and long-range effect of each application."

"The recent upturn in business . . .

activity will cause many business executives to give serious consideration to the need for an expansion of their automation plans. The recession has given machinery manufacturers a chance to incorporate many new technological developments into the machines they are now offering to the trade and, as a result, the productivity curve which was leveling off a year ago has again turned upward.

"Thus, opportunities for profitable investment in manufacturing facilities are better today than they have been for some time. Wise executives will invest now to protect themselves against future wage inflation and, at the same time, will minimize their capital investment because machinery prices are lower today than they will be at any time in the foreseeable future. For those who are confronted with the question, 'How far should a company automate today,' the answer can only be: The sky's the limit."

RALPH E CROSS
Executive Vice-president
The Cross Co
Detroit, Mich.

"Any company desiring to meet competition...

BERNARD GAIENNIE
Administrator of
Research and Development
Northrop Aircraft Inc

should automate, but within its specific requirements. It is just as possible for an organization to over-automate as it is to underdevelop the potential of a system. Too, there are problems of application which present factors of such magnitude that might outweigh the gains sought in automation.

"Management education will be the first problem encountered by a company contemplating automation. Active support from the top down is a prerequisite to effective application of this new technology. This support must be preceded by an understanding of the proper areas of application, effect on organizational structure, and other ramifications. System evaluation and selection constitute another problem of varying magnitude in the system-introduction phase, depending upon present organizational structure. The efficient preparation of machine-control intelligence requires the close cooperation of a machine-parts manager, cutting-tool designer, lines-layout or lost-data man, engineering liaison and machine-load planning. Complexity of establishing an efficient data-processing operation depends to a large extent on the degree of organizational separation that now exists between these skills.

"Work interchangeability between machines is another element that must be considered at time of acquisition of machines. Unless specifications are drawn up with interchangeability in mind, it will probably be impractical to attempt. Since an engineering drawing does not always define all the requirements for a particular part, quality-control problems will be many. A quality-control department must maintain a constant surveillance over control tapes to insure standards necessary for inspectors.

"Numerical control is, after all, the next logical step in the progression from simple hand tools to hand-power machines; to power machines, hand operated; to cam- or tracer-operated machines; to power machines, tape operated. It is important that any industry survey and study practical steps leading to the various phases of automation and the advantages it offers."

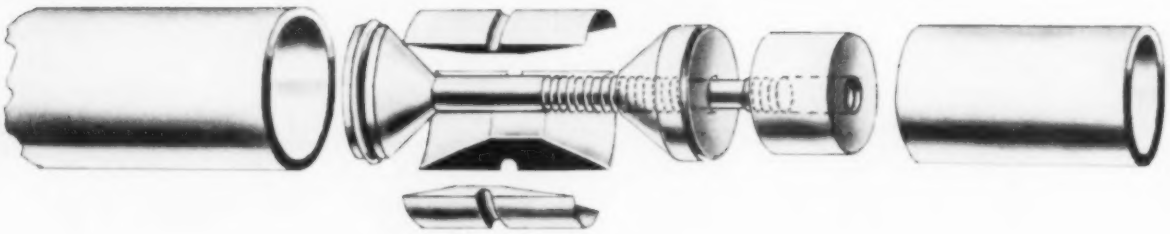
"Study the over-all problems of the company...

before deciding upon the extent of automation. Many points must be considered. One of the first and most important is the budget available for such a program. Other considerations include competitive position, time savings, availability of skilled labor, material savings, and others.

"Our Special Machine Division explores all the foregoing problems, and possibilities of automation in machining and assembly for the individual plant and a specific product. The company then recommends methods and equipment required to attain the desired extent of automation. Automation is an individual corporate problem, and can hardly be generalized because of the many factors involved. However, we feel that automation in all fields will contribute more and more to the progress of industry."

CARL F STUGARD
Manager, Special Machine Div
The Cincinnati Milling Machine Co

SIGNIFICANT COMPONENTS



Tubular friction lock . . .

can be encased, with no exposed or protruding parts, inside pipe or tube measuring ¼ to 2 in. ID. Can lock adjustable telescoping sections or join and lock two pieces of pipe with same diameter, making flush joint. Accommodates wiring running through interior. Continuous operation causes no scoring or marring of tubing walls. Made of aluminum bar stock or any other workable bar material. Can also be die-cast to specifications. Molded locks from such materials as nylon, PVC, cycolacs or epoxies are said to be least expensive for high production. Custom-made to specifications. Delivery in 30 days or less. **Aladdin Laboratories Inc, 620 S 8th St, Minneapolis.**

Circle 11, Reader Service Card

Wiper consists of bladed . . .

bronze rings and synthetic mounting ring; is reported to protect hydraulic systems, packings and component parts from foreign matter. Tapered blades remove foreign matter and throw it away from the rod and ring. Unit is self-adjusting; full-floating rubber cushion absorbs side loads and holds scraper rings in full contact with rod at all times. Synthetic rubber cushion ring is oil-resistant and has temperature range of –40 to 250 F. Available in ½ to 24-in. shaft dia, in increments of $\frac{1}{16}$ in. to 6 in. dia and in increments of ¼ in. from 6 to 24 in. dia. From stock. ½ to 6 in. dia units are $1 to $7.81 each in quantities of 1000 to 2499. **E F Houghton & Co, 303 W Lehigh Ave, Philadelphia 33.**

Circle 12, Reader Service Card

Noncombustible lubricant . . .

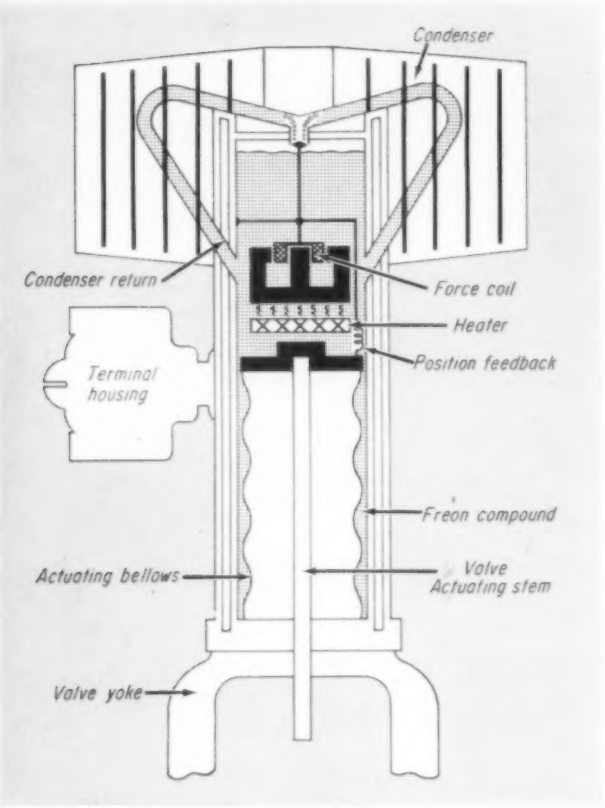
presents no flammability hazard with compressed oxygen, resulting in greatly reduced costs for production of industrial oxygen. Oil, based on chlorotrifluoroethylene polymers and produced within narrowly controlled physical characteristics, is chemically inert and resistant to attack by hazardous and most corrosive agents. In air or oxygen compressors, oil has been continuously circulated, through a filter, without evidence of breakdown. May be used in standard air compressors with minor equipment modifications. From stock. $12 per lb (16 lb to the gal). **Halocarbon Products Corp, 82 Burlews, Court, Hackensack, NJ.**

Circle 13, Reader Service Card

Miniature reversible motor . . .

for continuous operation maintains timing accuracy in clockwise and counterclockwise directions and synchronization during vibrations of 10 to 55 cps at 0.065-in. excursion. Shaft rotation may be reversed as often as required without damage to motor. The 80 oz-in. motor operates on 115 v ac, 60 cps. Output speeds range from ¾ to 3600 rpm. Operates in temperatures of –40 to 221 F and withstands shock of 100 g without damage. Enclosed in case, 1¾ x 2½ in. dia. Weighs 14 oz. About $8 in small quantities; $5.60 each for 1000 units. Delivery on production quantities in 3 to 4 wk. **Hurst Tool & Mfg Co Inc, Princeton, Ind.**

Circle 14, Reader Service Card



Thermal actuator positions . . .

valves or other final-control elements in electronic control systems by using expansive force of Freon vapor. Requires no compressed air, motors, gear trains, pumps, oil, amplifiers or relays. Develops force of 500 lb, opposed by 300-lb return-spring force, and gives a total stroke length of 1.5 in. Response speed is 0.1 in. per sec. Position repeatability is said to be accurate to 0.5%. Operation is based on controlled rate of heat release through Freon, which circulates in a closed chamber open only to a condenser. Heavy spring bellows coupled to actuating stem and mechanical position-feed-back device is within chamber. Control is achieved by varying bleed rate of Freon into condenser through a release valve operated by a coil. Operates on signals of 1 to 5 milliamp dc from 115-v, ac or dc unregulated power supply. Hermetically sealed unit is said to be unaffected by ambient temperatures of −50 to 140 F, line temperatures, radiant heat or adverse weather conditions. Explosionproof, suitable for Div I locations. About $500 each. Pilot production at present; production shipments in about 6 mo. **Swartwout Co, 18511 Euclid Ave, Cleveland 12.**

Circle 15, Reader Service Card

Coating permits machining . . .

boring, tooling and milling of parts without marring finish. Can be dipped or sprayed and then baked. Said to have withstood boring, high temperatures, extreme pressure and heat, alkali and acid baths, extreme cold and impact strength tests. Anticipated applications include undercoat finishes to protect durability of fine finishes on metal products or to be spray finished, without repainting, in final color. $5 to $7 per gal, depending upon color. 3 to 5 day delivery. **J Landau & Co Inc, Carlstadt, NJ.**

Circle 16, Reader Service Card

Magnetic control component . . .

combines characteristics of permanent and transient magnetic amplifiers. Differs from previous components of same type in that core contains both low- and high-retentive ferrites. When pulse passes through control coil around high-retentive ferrite, device is toggled "on" until second pulse passes through reset winding, causing low-impedance path for 10-mcs carrier signal to load. But when pulse passes through coil around low-retentive ferrite, signal passes to load only for duration of pulse. When both are "on," high-impedance path to load is created. Thus, it can function as a differentiating detector. Only one type is presently available, which should find application in AFC and AVC circuits in receivers, as magnetic proximity detector, and in low-level magnetic amplifiers. Said to offer high reliability up to 220 F. Space-saving component replaces transistors, resistors, capacitors and other conventional circuit elements. Introductory price is approximately $11 each. From stock. **Magnistor Corp, Sub of Potter Instrument Co Inc, Sunnyside Blvd, Plainview, LI, NY.**

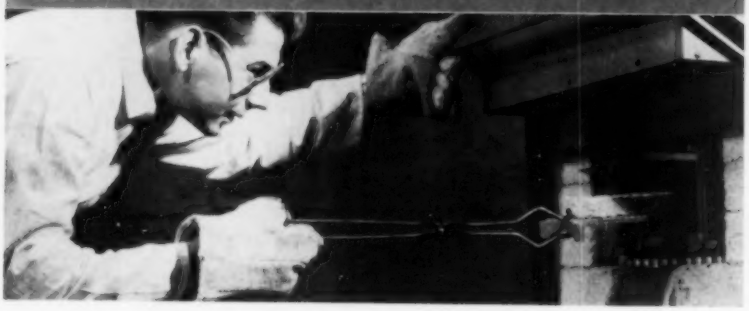
Circle 17, Reader Service Card

Automatic color control . . .

is offered by a new system of electronic focusing and light monitoring, which responds to minute color variations. Corrective motions are applied by servomotor systems, restoring predetermined color values without interruption of product flow. Color is scanned through a lens system. Alterations in color distribution are registered and transmitted as alterations in frequency and phase of fluctuating electric currents emitted by oscillating photoelectric cell or sensor. Sensor oscillates along predetermined path in focal area of lens. Deviations alter frequency and phase characteristics in a manner said to be well adapted to actuate servomotor controls. Inquiries for licensing of the system for specific applications are invited. **Comapco Inc, Suite 207, 17071 Ventura Blvd, Encino, Calif.**

Circle 18, Reader Service Card

CEC's new ceramic insulator for temperature, pressure, and shock



ceramicite

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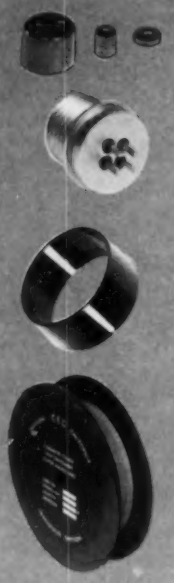
PRE-FORMED BEADS—Ready for firing by the customer, beads are offered in nine standard sizes and three Ceramicite materials for hermetic seals in different metals. Custom designs are produced for specific applications.

HERMETIC SEALS—Ceramicite seals are designed for high-temperature AN and miniature connectors, non-magnetic terminals for inertial guidance systems, receptacles for missile igniters, headers and bases for transducers, relays, and semiconductors.

COATINGS—Ceramicite provides an oxide-preventive, high-dielectric coating for stainless steel, titanium, K-monel, Inconel-X, and other uncommon metals in high-temperature and nuclear radiation applications.

MAGNET WIRE—Ceramicite-coated 1000°F magnet wire is now being manufactured by Hi-Temp Wires, Inc., Westbury, N.Y., and Sequoia Wire & Cable Co., Redwood City, Calif., under license agreement to CEC.

Write for Bulletin CEC 1590-X4 for the details on this exciting new development.



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300 North Sierra Madre Villa, Pasadena, California

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SIGNIFICANT COMPONENTS MATERIALS PROCESSES . . .

Silicone laminate . . .

in an economy grade is made from coarse-weave, continuous-filament glass fabric bonded with a silicone laminating resin. Said to combine high resistance to heat, flame, arc and moisture with good electrical and mechanical properties. Available in sheets or molded shapes. For ambient temperatures to 392 F. Color ranges from off-white to tan, with standard semigloss or special polished finish. **Continental-Diamond Fibre Corp, Newark 107, Del.**

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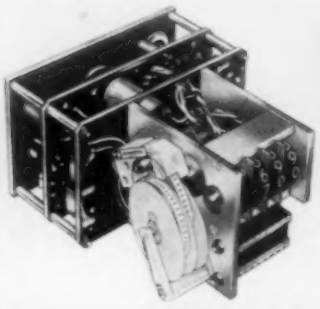

Miniature digital indicating converter . . .

for linear and nonlinear inputs is said to have accuracy of 0.1% with infinite slidewire. Servo-driven potentiometer has Zener-referenced power supply. 144 in standard slidewire is formed by bonding resistance wire within edge of laminated Mylar tape. During automatic calibration, specified digital values are printed on the tape or perforated for engagement of a positioning and driving sprocket. With transducers that employ strain gages, system indicates such factors as weight, pressure and force directly in any units desired; accuracy said to match that of transducer. With transducers that have resistive outputs, direct digital indication of narrow temperature spans is available with two readout arrangements. Calibration can be printed on tape and viewed through a window for linear, parabolic, hyperbolic or logarithmic functions in any scale units; or digital in-line counter can be geared to slidewire drive shaft that accommodates functions with a 15% variation in slope. With differential transformers, it can produce linearized digital indication for pressure and flow applications. For use with 115-v, 60 or 400 cps power, unit requires 20 va. Programming contacts are provided. Offered in two series. **B & H Instrument Co Inc, 3479 W Vickery Blvd, Fort Worth 7, Tex.**

Circle 20, Reader Service Card

Wide range of premix moldings by the Plastics Division of General American Transportation Corporation includes: automotive air conditioning cabinet for O. A. Sutton Corp., Inc.; Silvertone portable TV cabinet for Sears, Roebuck and Co.; air duct and glove compartment for a leading automobile manufacturer; vending machine air duct for Vendo Co.

Premix moldings give you all three... quality, economy, versatility

Like to market better products and cut costs at the same time? Then premix moldings are for you!

When resins and reinforcing fibers are blended beforehand, more complex molds are not only possible but completely practical. Slots, grooves, holes, bosses and parts with varying wall thicknesses can be formed right in the mold. And whether the part is simple or complex, you'll get moldings with uniform strength and wall thicknesses. Premix moldings are improving products and cutting costs for a wide variety of industries using strong, rigid, reinforced plastics.

Molders across the nation rely on Dow Vinyltoluene and Dow Styrene for top-quality premix moldings. They can help you to better products at lower costs. For the names of molders and suppliers, contact your nearest Dow Sales office or write to THE DOW CHEMICAL COMPANY, Midland, Michigan, Plastics Sales Dept. 2206K-2.

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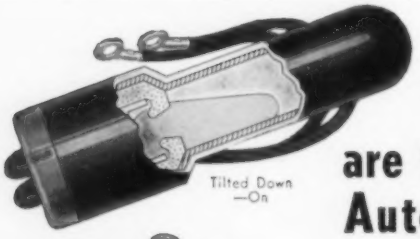
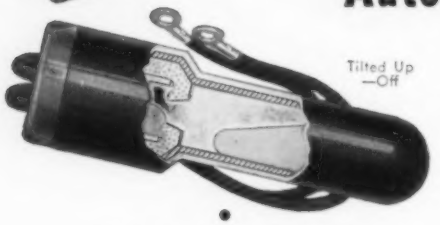


DURAKOOL
Tilt Switches
are the Life of your
Automatic Controls



This steel-clad Durakool mercury tilt switch has unique construction features that deliver years of trouble-free performance on the most difficult assignments you can find. Operating under sealed-in, pressurized hydrogen gas, it takes 24 hours, fast cycling schedules in stride. 7 sizes, 1 to 65 amperes. Send for Bulletin D-49.

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ELKHART, INDIANA, U.S.A.
700 WESTON RD., TORONTO 9, CANADA

Durakool ALL-STEEL MERCURY Switches

SIGNIFICANT COMPONENTS
MATERIALS
PROCESSES . . .

Speedier cam fabrication . . . especially for master, experimental and prototype cams is possible because of automatic computer process that needs only points on cam surface dictated by application. Servo-controlled machine tool cuts finished cams. Follower and hub dimensions are needed in addition to timing diagram coordinates. Delivery is usually within 48 hr. Suited to face, cylindrical and disk cams, particularly those for high-speed applications. Limited-quantity production runs are also said to be feasible. **Cam Engineering, Div of Howard Holmes, 447 Tarrytown Rd, White Plains, NY.**

Circle 21, Reader Service Card

Digital torque indicator . . . also supplies output proportional to horsepower. Output, combined with that of a dc tachometer-generator, is fed to a strip chart recorder for a continuous direct-horsepower reading. Input is received from a standard strain-gage torque meter and torque values are continuously indicated on a front panel in in.-lb or ft-lb. Indicator is said to be unaffected by line-voltage variations, servoamplifier gain changes and ambient-temperature fluctuations. Basic indicator accuracy is 0.15%. Operates on 115 v ac, 60 cps. Constant voltage supply within the instrument prevents it from responding to line transients. **Performance Measurements Co, 15301 W McNichols, Detroit 35.**

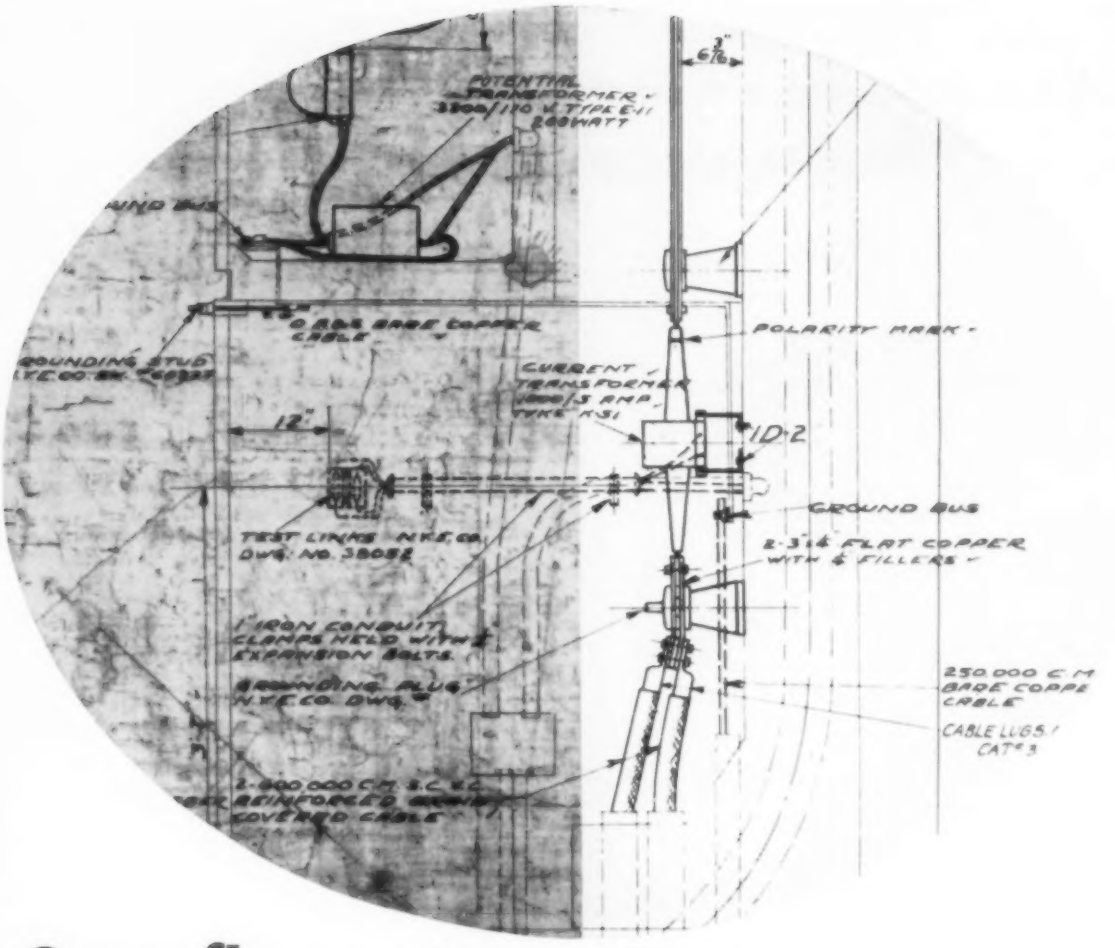
Circle 22, Reader Service Card

Stainless honeycomb floats . . . on water, yet meets strength requirements for aircraft scheduled to fly at anticipated speeds of over 2000 mph. Material, ½ in. thick, consists of hexagonal steel cells with thin sheet of stainless brazed on both sides of the honeycomb. Said to have same strength as solid stainless steel of same thickness, but to weigh only 1/10 as much. Honeycomb also meets heat-resistance specifications for supersonic aircraft. Limited quantities have been produced. **Crosley Div, Avco Mfg Corp, 1329 Arlington St, Cincinnati 25.**

Circle 23, Reader Service Card

Heavy-duty time switch . . . controls substantial loads even under severe operating conditions. Rated 55 amp at 120 or 240 v ac. Synchronous, self-starting motor maintains speed at temperatures from −20 to 150 F. **Paragon Electric Co, Two Rivers, Wis.**

Circle 24, Reader Service Card



Cronaflex prints clean:

TRADEMARK

Eliminates kinks, smudges, creases from original drawing

Examine these two prints. The one on the left, on cloth, bears the same scars of age and wear as the old original drawing. The copy on the right, made from the same original, is on CRONAFLEX. See how CRONAFLEX has eliminated the kink marks, cleaned up the smudging—actually improved the drawing.

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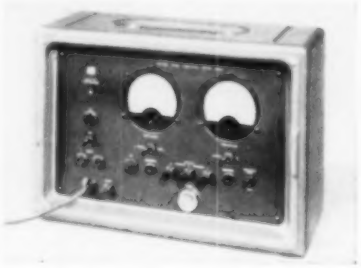

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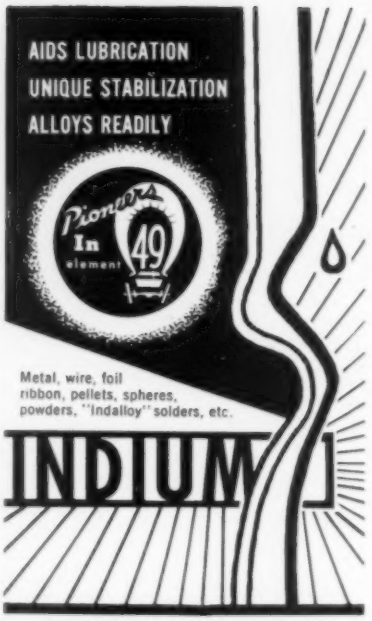

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NEW LITERATURE

On the Magnet

SIR WILLIAM GILBERT. *Published in facsimile from a copy of original Sylvanus Thompson English edition by Basic Books Inc, 59 Fourth Ave, New York 3. 317 pp, 8 x 12½ (boxed). $8.50.*

Certainly the first scientific works based on the modern scientific techniques of experimentation and observation belong in today's engineering libraries. Yet only with the publication in facsimile of Gilbert's *On the Magnet* are the two books which first challenged the speculative assumptions of Aristotle and the 2000 years following his death readily available. Until now, both this book and Agricola's *De Re Metallica* (see review below) were collector's items.

The two were published (originally in Latin) only 44 years apart (*De Re Metallica*, 1556; *On the Magnet*, 1600), and together they provided much of the foundation for the great scientific discoveries and technological developments of the 17th, 18th and 19th centuries. Gilbert knew of his predecessor's work, for *On the Magnet* contains a number of references to the earlier volume. A particularly interesting coincidence shared by these two books is the profession of their authors. Both were notable medical men—Gilbert was Royal Physician to Queen Elizabeth I.

Perhaps it was Gilbert's training and work as a practitioner that led to his insistence on exhaustive experimentation and observation as a basis for his conclusions. This truly scientific procedure was characteristic of all Sir William's work and it should be kept in mind by the reader, because of the almost theological atmosphere and Aristotelian terms that prevail.

The volume is composed of six books, and they describe and explain Gilbert's discoveries of the basic laws of magnetism and static electricity. Book VI, which discusses the rotation of earth and its magnetic characteristics, has generally been removed or mutilated in those copies of the original Latin editions that have been found in Italy, one of the principal seats of the Inquisition. JK

Agricola on Metals

BERN DIBLER. *Burndy Library, Norwalk, Conn. 128 pp, 8¼ x 10 ¾. $2.50.*

Georgius Agricola's book *De Re Metallica* was written in the lingua franca of its day, Latin, and was published one year after his death (1555). The book was immediately translated into German and Italian and was repeatedly reissued, remaining the leading textbook for miners and metallurgists for nearly two centuries. The most modern translation into English was accomplished by a contemporary mining engineer and his wife of some note, Mr. and Mrs. Herbert Hoover. This edition was republished in 1950 by Dover Publications Inc (1780 Broadway, New York 19, $10). Like Gilbert, Agricola rejected all explanations for natural phenomena that were not based on "those things which we see with our eyes and understand by means of our senses."

As a result, his book is an encyclopedic, profusely illustrated record of the scientific and engineering basis of mining, metallurgy and metalworking in Western Europe up through the first half of the 16th century. Agricola's explanations of the formation and distribution of ores and his classification of minerals have proved startlingly accurate, based as they were on objective observation and deduction.

Dibler's study is intended for those primarily interested in the historical setting and significance of *De Re Metallica*. Over 70 illustrations from an original edition in the author's library are included. Dibler reviews the stage at which geology, mining and metallurgy were in Agricola's times and then explains his influence on these fields through the following 200 years. JK

COMPARISON OF STEEL BARS—11 x 17 wall chart, 5 pp, lists all AISI grades of cold-finished steel bars. Chemical analysis of 241 grades are given, as well as machining ratings in surface fpm or as a percentage compared to AISI Grade B1112. There is also a table of weights, which gives weights in lb/ft for round, square and hexagon steel bars of thicknesses or diameters from ⅛ to 6 in. Charts fold in half for filing. La Salle Steel Co, PO Box 6800-A, Chicago 80.

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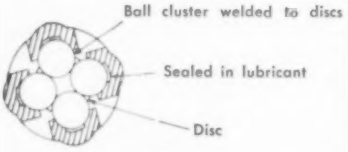

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Publisher's Postscript...

Back-patters

Most publications regularly print complimentary letters in their "Reader to Editor" columns. Readers approve of an article, are grateful for a new point of view or are delighted to find some kindred spirit who reached the same conclusions and had the courage to write them. And this gives editors an opportunity to brag a bit, in public, about what a fine job they are doing.

Well, Product Engineering editors don't do this. Every published letter has something specific to offer the reader—whether it takes issue with an author or editor, or offers additional information or a correction. In each case the writer has said something that other readers would want to know.

Editorial modesty, you say? I doubt it. Editors are no more modest than most people.

Maybe they don't get any? But they do:

". . . were among the best 'vignettes' of their kind that I have read for a long time . . . This is the sort of thing that puts life into science and engineering and makes it interesting."

"Reading it was like sticking one's head out of a stuffy room to get a breath of fresh air. I could find nothing . . . that did not stand up to the facts as we know them."

". . . an unusually competent synthesis of rather difficult material."

No, I think the reason they don't usually print letters like these comes from their training as engineers. Painters sign their work, authors get full credit in a byline, politicians have laws named after them and generals ride statues in city parks. But products don't carry the name of the engineering designer—only of the manufacturer. Engineers don't brag in public, perhaps they're too conscious of the imperfections of the finished work, or they're too taken up with the next problem to waste time "talking up" (or selling?) the last.

And so it is with technical editors. A complimentary letter is a delight to receive—it means at least one reader got something from the article. The editor struts a bit in the privacy of his office, and smiles, and then puts it aside to take up the job again.

So a reader (yes, and a publisher) may wonder if no one ever thought to write and say "thankyou". They have and do. I recently looked through a thick folder of such letters, and they made me very proud to be a part of this publication. Your letters are pondered, discussed, published if of wide reader interest, and very welcome, always.

—A. H.

74 For Your Information (personal)

Out, out—Spot!

Mechanization has the erasing field well in hand.

Whether it's a pencil mark or an echo you want to remove, there's a new gadget to do the job with a minimum of effort.

For instance, the battery-powered eraser pictured below, left. It retails at $4.95 (less batteries, which fit in closed section of the carrying case), comes complete with two erasers (gray for type, pink for pencil) and an emery disk for sharpening them up. Ellendale Associates, P. O. Box 401, Park Ridge, Ill., is the distributor.

The sound eraser (right) doesn't even need power to do its work, says its developer, Audio Devices Inc, New York City. Designed to remove print-through (unwanted echoes) from tape recordings, its

Portable ink-eraser

Attachable echo-remover

work is done by a small brass bar (1½ by ⅜ by ¼ in.) with a magnetized stripe and a chromium-plated bearing surface. This assembly fits over a ¾-in. base plate that is permanently installed on a tape transport so that the tape contacts the magnetized area of the "Echoraser" at a specific angle. Then, Audio's engineers say, magnetic action of the energized area simply lifts the print-through off the tape like an eraser moving over a blackboard. "Echoraser" will go on the consumer market shortly in a package that will contain two units: one to remove print-through up to 9 db; the other up to 18 db. Price—about $12.50.

Two-faced sticker

Adhesive strip, given "an attractive wood-grain finish" and coated on both sides with a pressure-sensitive adhesive, is now available for bulletin board and workshop use. Quantity prices for 1 by 9-in. strips imprinted with names or instructions range from 3½ to 7¢ a strip. Creative Sales Co, the distributor, says the adhesive is nonstaining and nondrying, permits repeated removal and reuse.

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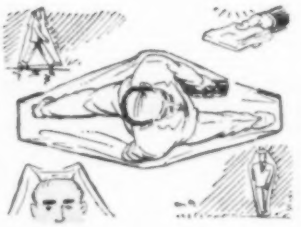
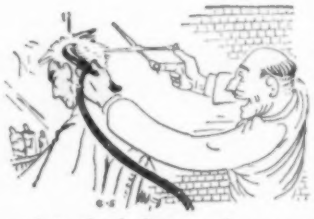
WHY DON'T THEY RESEARCH and DEVELOP...



. . . something new in rainwear? Umbrellas haven't changed in centuries. Women's hair still straightens and falls at the first rise in humidity. Men's creased trousers turn baggy and their cuffs are a disgrace no matter how long the raincoat. The new synthetic textiles are one solution. Weather control is another possibility. Covered streets or even domed cities would be effective, though individual protection would be preferable. What can you suggest? —R. MYRAM

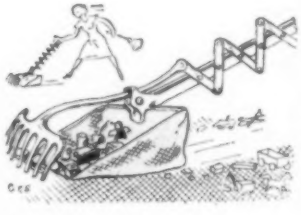


. . . a molded plastic comb with a hollow shaft in the solid edge and hollow teeth. A barber could attach a rubber tube to one end and vacuum the small itchy hairs as he combs and cuts. The hairs may have trouble finding their way into the hollow teeth so an alternative might be a hair brush with larger openings around the bristles to suck up the hairs.

—A. G. DEARE

. . . a fast-drying ink with all the other desirable properties of India ink. It should not smear within seconds after a line is drawn so that a draftsman need not use excessive care. If this is impossible (a fast-drying ink is hard to handle in an ordinary pen), how about a drafting machine supported just above the paper so that it can be used as fast as necessary without concern for ink smears.

—B. H. SCHOFIELD



. . . a plastic rake to help mothers gather up the toys children scatter throughout the house. A mother has a lot of bending to do which might be eliminated if she could sweep up the toys and lift them into the toy chest in one motion. —C. L. FLESSATE

Have you a pet subject but neither the time nor inclination to do the necessary R & D? Product Engineering will welcome (and pay $10 each for) similar ideas based on known scientific principles but lacking an inspired manufacturer

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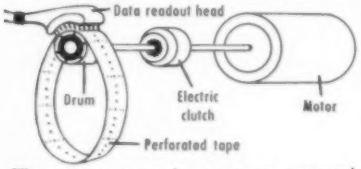
Electric Motion Control IDEAS from Warner

New ways to improve products with electric brakes and clutches

Quick-acting power link for tape-indexing drum

PROBLEM: To index a feed drum one frame of ten lines so a readout head with wire-mesh fingers can detect 80 signals simultaneously from tape perforations. Fingers drop through perforations and contact the silver-plated drum, supplying 60 to 100 bits per step for rapid readout.

Power is from a continuously running motor through a Warner stationary-field electric clutch-coupling. An electronic control unit energizes the clutch field with a 10-millisecond pulse for each 60-deg index. When the clutch is energized, flux flows from the field (stationary-mounted) to the rotor, which is keyed to the drive shaft.



The rotor attracts the armature, mounted on a spline-drive hub to the driven shaft, powering the paper feed drum. Drum rotation never reaches motor speed. Driving occurs in a slipping condition.

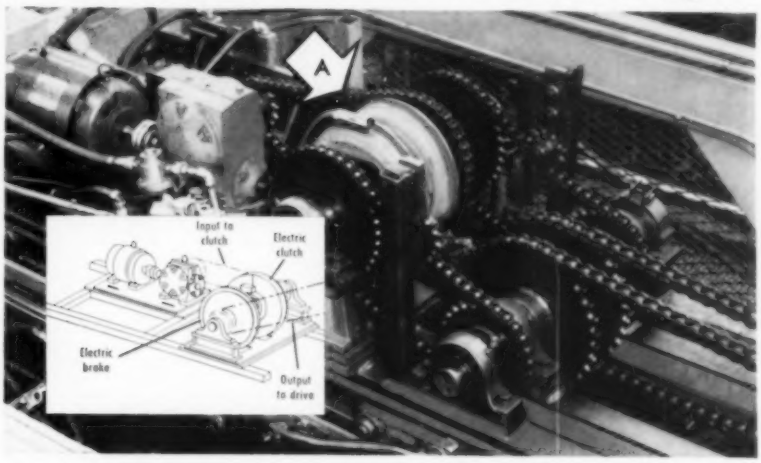
Complete 60° index in 30 ms

The Warner clutch is in the plate circuit of a type 6BG6 tube and is energized for about 10 ms. Parts are accelerated for about 9.5 ms at a torque of about 8 in.-lb. The drum reaches 490 rpm max. for each index.

To build up current in the clutch field, engage the armature and rotor, and start rotation of the drum, requires only .5 ms.

Friction in the clutch is between the rotor and the armature, either of which can be replaced in a few minutes without disturbing the electrical connections. The armature floats axially on a splined hub, providing automatic wear take-up.

Modular Power Drives Uncover Hidden Savings!

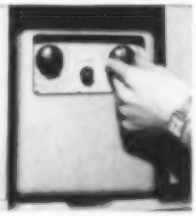


Electric clutch-brakes pass automation torture-test

A large automotive plant standardized its power drives for automation equipment, using Warner electric brakes and clutches for actuating motions at duty cycles up to 600 per hr. Purpose was to: (1) reduce peak period air consumption; (2) provide an accurate method of positioning work in automatic machinery; and (3) reduce maintenance costs. Proof of reliability is the fact that *no maintenance* has been required on 150 Warner units used for two years in this plant for applications like the one illustrated above —a straight-through drive, with right-angle jackshaft and clutch-brake (A) to actuate and position a work-elevating device.

Simplify to save

Fast, precise Warner electric brakes and clutches were not only the control answer for single-revolution cycling of automation equipment, their simple, compact design adapted well to all types of right-angle and straight-through mounting arrangements. They operate at high-duty cycles without heating up—no replacement parts have been required in two years of operation.

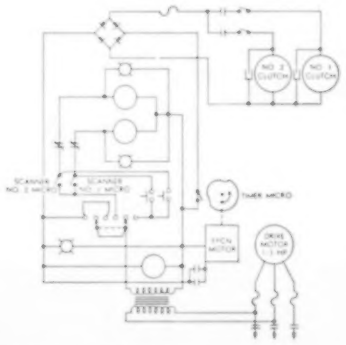


Another advantage is speed. Warner units require only 30 watts of d-c to energize the magnets and they release instantly when de-energized. This permits rapid switching from brake to clutch, and vice versa. Complex mechanical linkages and piping are eliminated and the only outside connection required when changing setups at this plant is an electrical plug into the control panel.

Torque adjustment like tuning a radio

Some automation drives require precise actuation, such as when loaders carry steel sheet under the forming dies. Packaged Warner controls (above) permit adjustment of torque build-up so the machinery delivers parts at correct speed for foolproof, automatic production.

Air Scanners Control Clutches



The electrical schematic shows how a printing press manufacturer solved a feed-through problem with two Warner electric clutch-couplings. They operate in opposite directions to drive a tilting bar which makes the running web of the press drift left or right, depending on the direction of tilt. When the roller tilts, the web creeps to the high side. Control is actuated by compressed air aimed at microswitches on either side of the web. In normal operation, the web blocks air to both switches; but, when it drifts, it uncovers a switch to be actuated by the air blast. This starts the drive and centers the web.

Send for more IDEAS

Write for factual application sheets showing how machines can be made more productive, easier to control, simpler to maintain with Warner electric brakes and clutches.

WARNER

INDUSTRIAL PRODUCTS DIVISION

Warner Electric Brake & Clutch Co.

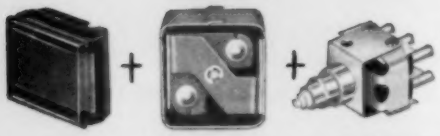
Beloit, Wisconsin

for: MISSILE, ELECTRONIC and INDUSTRIAL CONTROLS

NEW ELECTRO SNAP modular mounting lighted push-button panel switch

Simplifies Control Panels; Saves Space, Cuts Cost. May be used singly or in "stacked" arrangement.

3 UNITS IN 1 COMPACT MOUNTING



NAME-PLATE + PILOT-LIGHTS + PUSH-BUTTON SWITCH UNIT

In one compact assembly, this unit provides new space and cost economy whether used individually or in "stacked" arrangement. You get quality appearance with "thumb-size" operation.

This new Electro-Snap push-button panel switch efficiently combines a name plate, pilot light assembly and a switching unit in one compact modular assembly. The trim, streamlined design permits easy "stacking" on control panels or consoles. It eliminates congestion by replacing three individual units (nameplate, pilot light assembly and switch unit). You can achieve greater operating efficiency and quality appearance while making substantial savings in space and cost. A wide variety of configurations is available in:

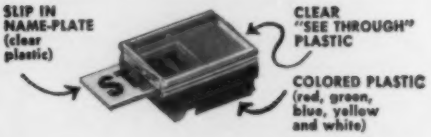
- circuit arrangements of switch and pilot lights
- colored buttons for color coding
- colored lights for color monitoring

The operating and indicating combinations possible through the variation of arrangements provides almost unlimited applications for sequencing, movement-limit, start-and-stop, position-indicating and similar control operations.

Check the design and construction advantages of this significant advance in panel switches for your own applications. For further details contact your local representative or write to:

ELECTROSNAP CORPORATION
4246 W. Lake St. • Chicago 24, Ill.
Tel. VA 6-3100 TWX #CG-1400

TWO-PIECE, PLASTIC NAME-PLATE PROVIDES EASY COLOR-CODING; SIMPLIFIES OPERATION IDENTIFICATION



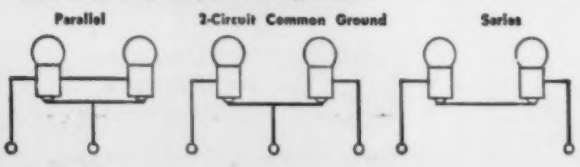
Virtually any operating condition can be identified with this push-button name-plate arrangement. The snap-in button is easily removed for insertion of slip-in name-plate. Use of various colored button bases, or various colored lamps, permits wide range of codings and monitoring.

- Snap-in button permits easy lamp replacement from front of panel
- Barrier can be color-anodized to your specification

The lighted push-button switch assembly is also available without the switch unit for use where only pilot light duty is required.

VARIETY OF CIRCUIT ARRANGEMENTS PERMITS WIDE RANGE OF INDICATING AND SWITCHING COMBINATIONS

- Lamp circuit can be wired independently of switch circuit—or through switch unit.
- Since two lamps are provided, independent external circuits can be indicated on single unit with different lamp colors and white push-button.
- Complete push-button switch unit or pilot-light assembly can be supplied in any of the three following circuit arrangements.

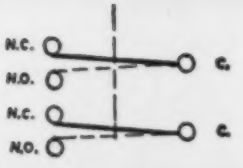


- 6V. or 28V. lamps may be used (solder terminals on lamp assembly)

Switch terminals available
- Solder
- Turret
- Double Turret
- AMP quick-disconnect

Switching Circuits to Meet Your Needs

The double-pole, double-throw switching unit may be wired normally-open or normally-closed.



a standard ELECTRO-SNAP UNIT

- Compact
- Space Saving
- Precision-Engineered
- Low Cost